A taxonomic revision of the genus *Gastrimargus* Saussure (Orthoptera: Acrididae)

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Synopsis

The economically important grasshopper genus *Gastrimargus* is revised. Twenty-three species and eight subspecies are described, keyed and illustrated. Five species and two subspecies are new to science, and the male of *G. hyla* is described for the first time. Sixteen species and five subspecies are synonymised and four species are reduced to subspecies. Two species and two subspecies are reinstated from synonymy. Sixty-four primary types have been examined including one newly designated neotype and eight lectotypes. Available data on the biology and economic importance of the species are reviewed and their distributions are mapped. The biogeography of the genus is discussed in the light of past and present geological, vegetational and climatic factors, and contrasted with that of the related genus *Oedaleus*, recently revised.

Introduction

History of the genus

Saussure (1884) originally described *Gastrimargus* as a subgenus of *Oedaleus* Fieber, characterized by its stouter general shape, longer pronotum, and certain supposed differences in the reticulation of the tegmina. The first species he described in his new subgenus was *G. verticalis*, but he did not formally designate it as the type-species. Kirby (1910) synonymised *G. verticalis* with *G. virescens* and designated *virescens* as the type-species of *Gastrimargus*. This designation is unaffected by the fact that *G. virescens* had already been recognised as a junior synonym of *G. marmoratus* (Stål, 1873), whereas *G. verticalis* was and is a valid species. Despite later attempts to substitute *G. verticalis* (Sjöstedt, 1928; Johnston, 1956), *G. virescens* remains the type-species of *Gastrimargus*.

Kirby (1910) also raised *Gastrimargus* to full generic status without, however, giving any reason for doing so. From the beginning there was confusion over the identity of some species, and their correct generic assignment was sometimes in doubt, *Oedaleus virgula* being placed in *Gastrimargus* (as *G. madecassus* Saussure, 1884) in error. The first revision of the genus, by Sjöstedt (1928), tended to confuse rather than to clarify the position. He described numerous species, varieties (understood here and by previous authors in the sense of subspecies) and forms. An indication of the scale of the problem is given by the synonymy of *G. determinatus procerus* (p. 282), which Sjöstedt described no less than six times under various names in the course of his revision.

Over the last half century a few new taxa have been described, and some new synonymy has been reported (Dirsh, 1961; 1966; 1970), but no general study of the genus has been undertaken. Descamps (1972) included *Gastrimargus* among the small group of old world oedipodine grasshopper genera most in need of revision. At the commencement of this study 32 species and five subspecies were recognised. In this work 16 species and five subspecies are synonymised, four species are reduced to subspecies, two species and two subspecies are recalled from synonymy, and five new species and two new subspecies are described. A total of 23 species and eight subspecies are now recognised for which keys and diagnoses are provided below. Because of the small number of available specimens of some species and the extensive geographical variation within some species-groups, some of the taxonomic conclusions reached here may have to be modified in the light of future collecting.

Economic importance

Members of the genus *Gastrimargus* are a conspicuous component of the tropical grassland ecosystems of Africa, Asia, and Australasia where, because of their numbers, they are sometimes considered injurious to pasture. Although there have as yet been no quantitative studies of their effects, the possible rôle of these and other grasshoppers as competitors of grazing stock is likely to assume increasing importance in tropical rangeland management.

Three species of *Gastrimargus*, *G. africanus* in Africa, *G. marmoratus* in South East Asia, and *G. musicus* in Australia are minor pests of agriculture. Of these, only *G. musicus* forms swarms and shows behavioural and morphological phase transformation (Common, 1948). The species is said to be favoured by overgrazing and deforestation, which provide bare ground for laying, and short and long grasses for feeding and roosting (Uvarov, 1977). In Malaysia *G. marmoratus* is often found in association with Lalang (*Imperata arundinacea*), an aggressive colonist in forest areas cleared for crops. In such areas *G. marmoratus* is able to move from the wild vegetation into the rice, maize, or other crop which is being grown.

With the continuing destruction of rain forest, and its replacement by vegetation types suitable for *Gastrimargus* species, it is likely that their importance as pests will grow. There is therefore a need for accurate identification of the species and a reliable knowledge of their ranges.References to economic importance are included in the text where appropriate, under species headings.

Methods and terminology

In this preliminary study characters for identification and separation of species were derived from the external morphology and colour patterns of both sexes, especially the hind wing, and the internal genitalia of the males. The terminology employed is that previously used for *Oedaleus* (Ritchie, 1981). Sjöstedt (1928) used the term 'cotypus' in the sense of the modern paratype, while others used it in the sense of syntype. Sjöstedt's cotypes are therefore referred to as paratypes whenever they are mentioned. In the genitalia figures (Figs 1–110), the phallic complex is consistently shown in both dorsal and lateral views with the epiphallic membrane and epiphallus removed. For brevity this information is not repeated in the figure legends. The scale line in each of the figures represents 1 mm. For each species the right half of the epiphallus is figured first in dorsal view and then in postero-ventral view to exhibit the degree of development of the lophi which is unclear in dorsal view.

For commoner species the recording of label data of material examined has been confined to listing localities of capture or, in extreme cases, countries only. Full lists are deposited in the

libraries of the Centre for Overseas Pest Research and the British Museum (Natural History). Except where otherwise stated, material examined is from the collections of the British Museum (Natural History), London. All distances and altitudes are given in SI units and all measurements of insects are in millimetres. Where possible place names in mainland China are given according to the Pinyin system. Doubtful names are quoted verbatim from the original label and are indicated by enclosure within single quotation marks.

Depositories

ORSTOM, Abidjan	Office de la Recherche Scientifique et Technique Outre-mer, Centre d'Adiopodoumé, Abidjan.
DA, Bangkok	Department of Agriculture, Bangkok.
MNHU, Berlin	Museum für Naturkunde der Humboldt-Universität zu Berlin.
IRSNB, Brussels	Institut Royal des Sciences Naturelles de Belgique, Brussels.
ANIC, Canberra	Australian National Insect Collection, Canberra.
IP, Eberswalde	Institut für Pflanzenschutzforschung, Eberswalde.
MZDS, Florence	Museo Zoologico della Specola, Florence.
MHN, Geneva	Muséum d'Histoire Naturelle, Geneva.
MCSN, Genoa	Muséo Civico di Storia Naturale, Genoa.
ZM, Hamburg	Zoologisches Institut und Zoologisches Museum, Universität Hamburg, Hamburg.
AFD, Hongkong	Agriculture & Fisheries Department, Hongkong.
BPBM, Honolulu	Bernice P. Bishop Museum, Honolulu.
RNH, Leiden	Rijksmuseum Van Natuurlijke Historie, Leiden.
ZI, Leningrad	Zoological Institute, Academy of Sciences of the U.S.S.R., Leningrad.
BMNH	British Museum (Natural History), London.
COPR, London	Centre for Overseas Pest Research, London.
NHM, Maastricht	Natuurhistorisch Museum, Maastricht.
UM, Oxford	University Museum, Hope Department of Entomology, Oxford.
MNHN, Paris	Muséum National d'Histoire Naturelle, Paris.
ANS, Philadelphia	Academy of Natural Sciences, Philadelphia.
DATS, Pretoria	Department of Agricultural Technical Services, Pretoria.
TM, Pretoria	Transvaal Museum, Pretoria.
NR, Stockholm	Naturhistoriska Rijksmuseum, Stockholm.
MRAC, Tervuren	Musée Royal de l'Afrique Centrale, Tervuren.
ZIUU, Uppsala	Zoologiska Institutionen, Uppsala Universitet, Uppsala.
NM, Vienna	Naturhistorisches Museum, Vienna.
USNM, Washington	United States National Museum, Washington.

GASTRIMARGUS Saussure

Gastrimargus Saussure 1884: 109, 110 [as subgenus of *Oedaleus* Fieber]. Type-species: *Gryllus virescens* Thunberg, 1815, by subsequent designation (Kirby, 1910: 226) [= *Gastrimargus marmoratus* (Thunberg, 1815) (Stål, 1873)].

Gastrimargus Saussure; Kirby, 1910: 226.

Medium size (total length 20–45 mm male, 24–64 mm female). Integument finely or moderately rugose and pitted. Antennae filiform, 0·80–1·25 times combined length of head and pronotum; flagellum with 22–27 segments.Fastigium of vertex concave, flat, or convex; raised marginal carinae distinct or indistinct, medial carina present or absent; fastigium narrowing to about half maximum width anteriorly, foveolae obsolete, or if present, triangular; frons in profile oblique or vertical, convex; frontal ridge with or without variable longitudinal sulcus, smooth, sometimes widening at median ocellus, widening evenly and obsolescent towards clypeus. Eyes oval, 1·2–1·5 times as deep as wide. Pronotum low to high tectiform with median carina from weakly raised to high blade-like (in *G. mirabilis*), intersected or not intersected by posterior sulcus; dorsum of pronotum sometimes with scattering of raised round warts; hind margin from rounded obtusangular (gregarious phase of *G. musicus*) to sharply acutangular (*G. mirabilis*); mesosternal interspace trapezoidal or rectangular, wider than long, narrower or wider anteriorly than metasternal; metasternal interspace usually forming a closed elongate lozenge-shaped area (but with narrow anterior opening to metasternum in *G. willemsei*). Tegmen and wings fully developed or slightly abbreviated, in male exceeding

hind knees by variable amount, in female sometimes not reaching hind knees but never by more than one-third of hind femur length; intercalary vein of medial area of tegmen usually well-developed and serrate, at least in males (unserrated in *G. acutangulus*); hind wing unspecialised. Hind femur normal, of variable thickness, lacking specialised features; hind tibia as long as femur, with 11–14 inner and outer spines, inner apical spurs about 1·5 times length of outer spurs; tarsi unspecialised, arolium 0·3–0·6 times claw length. Male supraanal plate shield-shaped, rounded triangular; male cercus subconical to finger-shaped, 2·00–2·75 times its basal width; subgenital plate subconical with rounded apex. Genitalia typically oedipodine, similar to *Oedaleus*. Aedeagus (paired apical penis valves) short, variably projecting from short enclosing cingular rami, and bearing a subapical ventral process of variable size; epiphallus bridge-shaped with bilobate lophi, outer lobes often acutely projecting. Ovipositor of variable length, not markedly elongated; ventral valves variable in shape and degree of sclerotisation, usually with simple acute apex (bifurcated in *G. willemsei*); basivalvular sclerites rugose or smooth.

General coloration: brown with green/brown polymorphism variably expressed as lighter brown or green markings on frons, vertex, genae, pronotum, hind femora, and anal area of tegmen (dorsal surface when folded); pale oblique band on genae continued onto pronotal shoulders, sometimes partly or completely obscuring ×-marking, and occasionally forming a light border to dorsum of pronotum; ×-marking when visible cream, light brown, or light green, with anterior and posterior arms joined separately on each side of median carina; anterior or posterior arms or both may be obsolete. Tegmen usually opaque brown in basal half or two-thirds, green in anal area of green morphs, with two or three transverse pale bands extending variable distance from costal margin, situated one-eighth, one-quarter, and one-half along from base, sometimes somewhat more distally placed; bands sometimes reduced or, occasionally obsolete; remainder of tegmen clearing towards apex with dark speckling. Hind wing with or without fascia; basal area pale blue, pale greenish yellow, pale yellow, or bright sulphur yellow. Hind femur usually with two or three oblique transverse bands externally, coinciding with darker areas between pale bands of folded tegmen, producing camouflage effect; bands may be reduced or obsolete, with or without residual spotting on upper and lower carinulae; internal surface with or without transverse band sometimes coalescing to form solid brown or black zone in basal half of medial area; internal ventral surface red, black, blue, or straw-coloured; hind knees brown to black, hind tibiae yellow, orange, red, brown, purple, or straw-coloured.

Taxonomic affinities and diagnostic characters

The genus *Gastrimargus* is classed among the Oedipodinae by virtue of its serrated medial intercalary vein and banded hind wings (the latter absent in extreme forms of *G. rothschildi* and *G. determinatus*). It is allied to *Locusta* L., *Oedaleus* (Ritchie, 1981), *Humbe* Bolívar, and *Oreacris* Bolívar, but may be differentiated from these and other genera of Oedipodinae by the following combination of characters.

1. Pronotum with median carina raised, arcuate, not deeply excised by posterior sulcus (as in *Pycnocrania* Uvarov, *Oreacris*).
2. Pronotal pattern, when visible, consisting of light ×-marking with anterior and posterior arms joined (separate in *Oedaleus*).
3. Tegmina with serrated intercalary vein, but without specialised stridulatory cross-veins (as in *Heteropternis* Stål or *Homoeopternis* Uvarov).
4. Hind femur lacking expanded upper or lower marginal area (as in *Oedipoda* Latreille or *Pycnodictya* Stål).
5. Genitalia with aedeagus short, never elongated (as in *Locusta*).

The species of the genus form a close-knit group, more closely allied even than those of *Oedaleus*. The recognition of distinct 'species-groups' based on common characters is therefore problematic, but loose assemblages can be made. In this study therefore the species are arranged in groups on the basis of apparent relationships as follows: *G. africanus*, *G. nubilus*, *G. lombokensis*, *G. subfasciatus*, *G. musicus*, *G. marmoratus*, *G. immaculatus*; *G. hyla*, *G. rothschildi*, *G. verticalis*; *G. miombo*, *G. determinatus*; *G. crassicollis*, *G. drakensbergensis*; *G. obscurus*, *G. wahlbergii*, *G. angolensis*. The remaining species are ungrouped. Interspecific affinities are discussed in detail under the species concerned.

Keys to the species of *Gastrimargus*

A key to the species of *Gastrimargus* was given by Sjöstedt (1928), but the large number of synonyms which were accorded separate species status and the unreliable characters used to distinguish them rendered the result valueless as a tool for identification.

The two keys provided here cover Africa and the remainder of the old world separately. The occasional cases of sexual dimorphism are dealt with by keying out sexes separately where necessary (e.g. *G. verticalis mpwapwae*). A more serious difficulty is posed by the large amount of geographical variation among the members of the *G. africanus-musicus*-group. The loss of wing and hind femur colour characters in specimens of *G. africanus parvulus* from Indo-China and Java, and *G. musicus* from the Solomon Is. leads to a situation where, without label data, positive identification would in a small percentage of cases be impossible. Males can be separated with difficulty (key to non-African species, couplet 11, p. 246), but no reliable characters have been found to separate females. However, in view of the observed clinal variation within the two species determination can be made on the basis of their discontinuous ranges.

Two *Gastrimargus* specimens from Nigeria, of uncertain identity, possibly *G. verticalis*, have been omitted from the keys. They are discussed under *G. verticalis* (p. 275) and the male is shown in Fig. 135.

Characters from the male genitalia, particularly the length and shape of the aedeagus and the shape of the epiphallic lophi, have been used in the keys and diagnoses, but caution is necessary in interpreting small changes in shape of these and other parts of the phallic complex. As in some other genera, there is general uniformity of shape over the genus as a whole but considerable variation within one species or even within one population. There are two major problems of interpretation of the genitalia. Firstly, new material is added to the endocuticle of internal skeletal structures daily throughout all or most of the adult life of grasshoppers (Neville, 1963). Thus, for example, the cingular apodemes (including the zygoma), and the aedeagal apodemes ('basal penis valves' of Dirsh) are continually extending and thickening at their anterior extremities. Up to ten or twelve growth layers can often be seen even by reflected light at fifty times magnification. Older animals therefore tend to have some features much more pronounced than younger ones, while in teneral insects the genitalia may be transparent and delicate, difficult to examine and easily deformed by handling. Secondly, the correct understanding of the epiphallus is complicated by its tendency to be curved or folded to a variable degree. If the epiphallus is considered in the position in which it is usually figured, lying on its ventral surface in the plane of the paper, there are three ways in which its apparent shape may vary. Firstly the anterior margin bearing the ancorae may be in the plane of the paper or curve upwards or downwards. Secondly the lateral plates with their anterior and posterior projections may also either lie flat or curve upwards or downwards, affecting the angle and shape of the lophi. Thirdly the bridge may be curved in the plane of the paper to a variable extent, altering the outline of the epiphallus and bringing the lophi closer together or pushing them apart. In view of these points specimens being compared must be examined in identical positions and from several angles. Genitalia drawings can only be used as a guide and should never be regarded as definitive.

African species

1 Hind wing bright blue basally (eastern and southern Africa) . . ***G. acutangulus*** (Stål) (p. 298)

– Hind wing basally colourless, pale yellow, or bright yellow, rarely pale greenish blue, never bright blue 2

2 (1) Tegmen length less than 20 mm ♂, 22 mm ♀, not or barely reaching hind knees in female . 3

– Tegmen length more than 20.5 mm ♂, 25 mm ♀, always exceeding hind knees in female . . 5

3 (2) Pronotal ×-marking with anterior arms distinctly curved, posterior arms not, or rarely faintly, visible (Fig. 150); posterior margin of pronotum rectangular to obtusangular; epiphallic lophi with relatively large, protrusive, and divergent outer lobes; posterior projection elongated and acute (Figs 100, 101); aedeagal valves strongly projecting, with large bulbous subapical ventral processes (Figs 98, 99); ventral ovipositor valves short, 1·2 times perpendicular basal width (Ivory Coast, Ghana, Zaire) . ***G. ochraceus*** Sjöstedt (p. 301)

– Pronotal ×-marking with anterior arms straight, no more pronounced than posterior arms (Figs 129–132); hind margin of pronotum acutangular; epiphallic lophi with outer lobes small, not protrusive or divergent (Figs 39, 40, 43, 44); aedeagal valves weakly projecting, with small subapical ventral processes (Figs 37, 38, 41, 42); ventral ovipositor valves longer, 1·45 times perpendicular basal width 4

4 (3) Pronotal ×-marking, when present, with straight posterior arms; hind margin of pronotum rounded acutangular (Figs 129, 130); lateral and ventral surfaces of thorax hairy; external upper and lower carinulae and medial area of hind femur with row of irregular brown speckles; tegmen length/pronotum length ratio 3·3 ♂, 2·4–2·7 ♀ (Ethiopia) ***G. hyla*** Sjöstedt (p. 268)

– Pronotal ×-marking with recurved posterior arms; pronotal hind margin sharply acutangular, at least in males (Figs 131, 132); thorax not hairy; external surface of hind femur unspeckled, with longitudinal dark stripe of variable thickness in upper half of medial area; tegmen length/pronotum length ratio 2·4–3·2 ♂, 1·4–1·9 ♀ (Ethiopia)
G. rothschildi Bolivar (p. 270)

5 (2) Dorsum of pronotum extremely elongated, more than 2·5 times length of lateral lobe; hind margin narrowly acutangular, forming an angle of less than 45° (Fig. 147); median carina high arcuate, blade-like, never intersected by posterior sulcus; hind femur narrow, elongated, length/depth ratio 5·1–5·7 ♂, 4·9–5·7 ♀; hind wing with complete fascia (Angola, Zaire, Zambia, Uganda) . . . . . ***G. mirabilis*** Uvarov (p. 295)

– Dorsum of pronotum shorter, less than twice length of lateral lobe; hind margin forming an angle of more than 45°; median carina never blade-like, sometimes intersected by posterior sulcus; hind femur thicker, length/depth ratio usually less than 5 ♂♀, if more, then hind wing fascia very incomplete or absent 6

6 (5) Hind wing with well-defined continuous dark band and bright yellow basal area . . . 7

– Hind wing with fascia continuous, interrupted, or absent, but basal area never bright yellow 8

7 (6) Tegmen length/pronotum length ratio 3·2–3·7 ♂, 2·9–3·6 ♀; inner and outer surfaces of hind femur with rows of irregular black specks on upper and lower carinulae; pronotal ×-marking variable, but usually distinct (Fig. 141); aedeagal valves strongly projecting, with large, bulbous subapical ventral processes (Figs 64, 65) (Zimbabwe, South Africa)
G. crassicollis (Saussure) (p. 285)

– Tegmen length/pronotum length ratio 3·9–4·6 ♂, 3·8–4·6 ♀; hind femur without dark specks on carinulae; pronotal ×-marking, especially posterior arms, usually indistinct (Figs 121, 122); aedeagal valves weakly projecting, with weak subapical ventral process (Figs 1, 2) (Subsaharan Africa) . . . . . ***G. africanus africanus*** (Saussure) (p. 248)

8 (6) Ventral surface and interior ventral carina of hind femur red; ventral ovipositor valves short, less than 1·25 times their perpendicular basal width (Angola) . . ***G. insolens*** sp. n. (p. 297)

– Ventral surface and interior ventral carina of hind femur black, blue-black, blue-grey, or straw-coloured, never red; ventral ovipositor valves longer, more than 1·25 times their perpendicular basal width 9

9 (8) Ventral surface of hind femur blue-grey to blue-black 10

– Ventral surface of hind femur straw-coloured 13

10 (9) Pronotum dorsally smooth, without warts (Fig. 142); median carina low arcuate (South Africa) . . . . . ***G. drakensbergensis*** sp. n. ♂ only (p. 288)
(♀ have hind femur ventral surface straw-coloured, not blue-black)

– Pronotum dorsally rugose, with numerous small globose warts; median carina high arcuate 11

11(10) Female pronotum length less than 11·6 mm, tegmen length less than 28 mm; male with strong complete wing fascia and apical half of wing strongly infumate (Fig. 143); outer lobes of epiphallic lophi forming a small circular bump (Figs 74, 75) (Zaire, Angola)
G. obscurus sp. n. (p. 290)

– Female pronotum length more than 12 mm, tegmen length more than 34 mm; male either with weak complete wing fascia and apical half of wing weakly infumate, or with strong fascia and apical half of wing clear (Figs 145, 146); outer lobes of epiphallic lophi laterally elongated, forming a lozenge-shaped bump (Figs 78, 79, 82, 83) 12

12(11) Hind wing fascia distinct, apical half of wing clear (Fig. 145); main wing veins usually tinted with pale blue basally; subapical ventral process of aedeagus bulbus, more strongly projecting (Figs 76, 77); outer edge of ventral ovipositor valves distinctly excavated (Fig. 80) (Eastern South Africa) . . . . . ***G. wahlbergii*** (Stål) (p. 291)

– Hind wing fascia indistinct, apical half of wing indistinctly infumate (Fig. 146); wing veins never tinted with pale blue; subapical ventral process of aedeagus less strongly projecting (Figs 81, 82); outer edge of ventral ovipositor valves smoothly curved, almost straight (Fig. 84) (Angola, Zambia) . . . . . ***G. angolensis*** (Sjöstedt) (p. 293)

13 (9) Hind wing without fascia (Fig. 138) (East and South Africa)
G. determinatus vitripennis (Saussure) (p. 283)

– Hind wing with partial or complete fascia 14

14(13) Hind wing fascia complete, apical half of wing infumate (Fig. 134) (Tanzania) ***G. verticalis mpwapwae*** sp. n. ♂ only (p. 277)
– Hind wing fascia complete or incomplete, apical half of wing never infumate 15
15(14) Hind wing fascia not extending further anteriorly than 1*A* 16
– Hind wing fascia extending to anterior margin of wing, narrowly interrupted between *Cu*2 and 1*A* (Figs 136, 142) 17
16(15) Hind wing fascia not reaching hind margin of wing in females; tegmen short, 21–25 mm ♂, 32–40 mm ♀; tegminal pattern distinct, with pale transverse bands strongly marked (Eastern and southern Africa) . . . . . ***G. verticalis*** (Saussure) ♀ & some ♂ (p. 273)
– Hind wing fascia reaching hind margin of wing posteriorly in both sexes (Fig. 137); tegmen longer, 25–34 mm ♂, 42–48 mm ♀; tegminal pattern pale and indistinct, light transverse bands weakly marked (Fig. 137) (West and Central Africa to Uganda) ***G. determinatus procerus*** (Gerstäcker) (p. 282)
17(15) Anterior arms of pronotal ×-marking meeting posterior arms at an angle of 90–120°; metazona with indistinct pale striae extending obliquely outwards and backwards on each side of median carina to hind margin (Fig. 136); ventral ovipositor valves with outer edge excavated (Fig. 56) (Central Africa) . . . . . ***G. miombo*** sp. n. (p. 278)
– Anterior arms of pronotal ×-marking meeting posterior arms at an angle of more than 125°; metazona without pale striae; ventral ovipositor valves with outer edge almost straight 18
18(17) Males 19
– Females 20
19(18) Size smaller: tegmen usually less than 25 mm; pronotal ×-marking with very thin arms; hind wing band strongly incurved towards anal margin of wing, distinct as far as 6*A* (Fig. 133); aedeagus only moderately protruding from cingular rami (Figs 45, 47) (Eastern and southern Africa) . . . . . ***G. verticalis verticalis*** (Saussure) (p. 275)
– Size larger: tegmen more than 25 mm; pronotal ×-marking with thicker arms; hind wing band weakly incurved towards anal margin of wing, fading beyond 5*A* (Fig. 139); aedeagus strongly projecting from cingular rami (Figs 57, 58) (Cape Province) ***G. determinatus determinatus*** (Walker) (p. 282)
20(18) Smaller insects: tegmen length less than 31 mm; hind wing with distinct broad fascia reaching anal margin of wing and incurving towards inner edge (Fig. 142) (South Africa) ***G. drakensbergensis*** sp. n. (p. 288)
– Larger insects: tegmen length more than 36 mm; hind wing with fascia not reaching anal margin of wing, and only weakly incurved towards inner edge, fading beyond 5*A* (Fig. 140) (Cape Province) . . . . . ***G. determinatus determinatus*** (Walker) (p. 282)

Non-African species

1 Hind wing with basal area pale blue (Timor) . . . . ***G. subfasciatus*** (de Haan) (p. 256)
– Hind wing basal area never blue (bases of major wing veins occasionally tinged with pale blue; see couplet 10) 2
2 (1) Hind wing without fascia (Arabia) . . . . . ***G. determinatus arabicus*** Uvarov (p. 285)
– Hind wing with partial or complete fascia 3
3 (2) Apical half of wing beyond fascia infumate, becoming as dark as fascia at tip of wing (Fig. 152) 4
– Apical half of wing clear, wing tip sometimes infumate 6
4 (3) Head small, femur length/head width ratio more than 3·6 ♂, 3·4 ♀ (Fig. 152); hind wing basal area bright sulphur yellow (New Caledonia) . . . . . ***G. sarasini*** (Saussure) (p. 305)
– Head larger, femur length/head width ratio less than 3·6 ♂, 3·3 ♀; hind wing basal area pale yellow, pale greenish yellow, or colourless 5
5 (4) Hind wing with some darkened cross-veins in basal area (Fig. 151); metasternal interspace with narrow anterior medial opening, continuous with metasternum; epiphallus with lophi protruding backwards beyond posterior projections, outer lobes of lophi elongated, incurved (Figs 104, 105); ventral ovipositor valves long and apically bifurcated (Fig. 106); New Guinea) . . . . . ***G. willemsei*** sp. n. (p. 303)
– Hind wing without darkened cross-veins in basal area (Fig. 123); metasternal interspace closed; epiphallus with lophi not protruding backwards beyond posterior projections; outer lobe subtriangular, not incurved (Figs 10, 11) (Himalayas) . ***G. nubilus*** Uvarov (p. 252)
6 (3) Internal ventral surface of hind femur red (except *G. musicus* in Solomon Is.) 7
– Internal ventral surface of hind femur straw to blue-black, never red 8

7 (6) Small species, tegmen length less than 25 mm ♂, 32 mm ♀; hind wing basally pale yellow; fascia narrowly interrupted between *Cu*2 and 1*A*, with posterior portion thinning at its anterior end and curving inwards towards wing base along 2*A* (Fig. 124) (Lesser Sunda Is.) ***G. lombokensis*** Sjöstedt (p. 254)

– Larger species, tegmen length usually more than 25 mm ♂, 32 mm ♀ (females sometimes smaller in Solomon Is.); hind wing basally bright sulphur yellow (except in E. New Guinea and Solomon Is. where paler); fascia broad throughout, not incurved towards wing base along 2*A* (Fig. 126) (Australia, Tasmania, New Guinea, Solomon Is.) ***G. musicus*** (Fabricius) (p. 258)

8 (6) Internal ventral surfaces of hind femur blue-grey to blue-black (Arabia, Madagascar, India) ***G. africanus*** (Saussure) (p. 246)

– Internal ventral surface of hind femur straw-coloured 9

9 (8) Hind wing fascia thin and indistinct, variably interrupted between *M* and 2*A*, sometimes between costal margin and 3*A* (Fig. 128) (Reunion) . . ***G. immaculatus*** (Chopard) (p. 266)

– Hind wing fascia distinct, complete 10

10 (9) Hind wing fascia, especially in female, with dark pigment diffusing outwards along 3*A* and subsequent veins towards wing tip (Fig. 127); main wing veins usually faintly tinged with pale blue basally; hind femur with external upper marginal and sometimes medial areas immaculate, unicolourous light brown or green; internal surface straw-coloured, with small brown patch in basal half of medial area only (South East Asia: Assam to W. New Guinea) . . . . . ***G. marmoratus*** (Thunberg) (p. 262)

– Hind wing fascia not diffusing outwards along wing veins; bases of wing veins not blue-tinged; hind femora usually with oblique transverse dark bands on external medial and upper marginal areas; internal medial area entirely black in basal two-thirds, separated from apical transverse black band by subapical pale zone 11

11(10) Male cercus blunt, finger-like, with convexly rounded lower edge; aedeagus strongly projecting (Figs 20–23) (Solomon Is.) . . . . . ***G. musicus*** (Fabricius) (pale race) (p. 258)

– Male cercus acute, triangular, with concave lower edge; aedeagus weakly projecting (Figs 1–3) (Indo-China, Java, Kangean Is.) . . . . ***G. africanus parvulus*** Sjöstedt (p. 251)

Descriptions of the species

Gastrimargus africanus (Saussure, 1888)

(Figs 1–7, 116, 117, 121, 122)

Oedaleus (*Gastrimargus*) *marmoratus* var. *africana* Saussure, 1888: 39.

This species is here divided into four subspecies under which the specific synonymy is separately listed.

Diagnosis. Fastigium of vertex concave. Pronotum with median carina moderately arcuate, shallowly intersected by posterior sulcus; hind margin sharply or bluntly acutangular; dorsum smooth. Tegmen surpassing hind knees by one-quarter to one-half of hind femur length, according to subspecies. Genitalia (Figs 1–7): aedeagus very short, usually with small variable subapical ventral process (more pronounced in *G. a. sulphureus*, Fig. 3): epiphallus rather variable in outline, with protruding conical outer lobe of lophi slightly divergent to slightly convergent.

Coloration. Dorsum of pronotum with pale × -marking often partly or completely obscured. Tegmen with basal pale transverse band sometimes reduced or absent. Hind wing with complete fascia (Figs 121, 122); basal area usually bright yellow (paler and sometimes greenish in subspecies *parvulus* and *sulphureus*); apex of wing variably infumate. Hind femur usually with three dark oblique transverse bands externally, sometimes obsolete in green morphs; internal surface with two basal bands forming black zone in medial area, apical band separate; interno-ventral carinula and ventral surface of hind femur blue-grey or blue-black (Africa, Madagascar, Arabia, India) to straw-coloured (China, Indo-China, Java). Hind tibiae basally brownish or reddish, subbasally straw, otherwise raspberry-red to dull pale reddish (in *G. parvulus*).

Affinities. *G. africanus* is allied to the African *G. crassicollis* (p. 285) on the basis of the shared complete fascia and bright yellow basal area of the hind wing and the blue shading of the underside of the hind femur. In Asia *G. africanus* has close affinities with the montane species, *G. nubilus* (p. 252), and in Indo-China there is sometimes a close approach in size and general

appearance to the larger *G. marmoratus* (p. 262). The nearly related Australian species *G. musicus* (p. 258) is easily differentiated by the red undersides of the hind femora, but is otherwise very close to *G. africanus*. *G. crassicollis*, *G. marmoratus*, and *G. musicus* all have a distinctly longer aedeagus than *G. africanus*.

DISTRIBUTION (Figs 116, 117, and Biogeography section, p. 313). *G. africanus africanus* ranges across most of Africa south of the Sahara, S.W. Arabia and India. *G. africanus madagascariensis* is restricted to Madagascar. *G. africanus sulphureus* occurs in the mountains of Pakistan, Kashmir and Nepal, overlapping with the nominate race in the Simla hills of N.W. India. *G. africanus parvulus* is found in Indo-China and Java. Additional data for the distribution map were provided by Dr P. Basilewsky (MRAC, Tervuren) and Dr G. Demoulin (IRSNB, Brussels). Localities for the following countries were supplemented from the literature: Chad (Descamps, 1968), Cameroun (Descamps, 1953), Comoro Is. (Descamps & Wintrebert, 1969), Senegal (Roy, 1970), Ivory Coast (Gillon, 1974).

BIOLOGY. *G. africanus* frequents bare patches in tall grassland, open woodland and forest clearings (Jago, 1968; Joyce, 1952; Phipps, 1970). The species is often caught at light, and in Mali is believed to migrate between the Niger flood plain and the drier Sahel savannah (Descamps, 1965). There are normally two generations in drier areas (Descamps, 1953; Robertson & Chapman, 1962), but there may be three in Madagascar (Descamps & Wintrebert, 1966) and continuous breeding in Ghana (Chapman, 1962). The dry season is survived by both egg and adult (Gillon, 1974; Joyce, 1952; Robertson & Chapman, 1962). The egg stage may last 22–24 days during the rains (Golding, 1948; Davey *et al.*, 1959; Descamps, 1965). There are five or six nymphal instars (Davey *et al.*, 1959; Descamps, 1965) lasting 30–89 days in all (Davey *et al.*, 1959; Jerath, 1968). Details of the eggs and egg pod were given by Chapman (1961), Descamps & Wintrebert (1966), Katiyar (1960) (as *G. transversus*) and Phipps (1971). Birds, spiders, and *Scelio* spp. have been reported as natural enemies (Descamps & Wintrebert, 1966; Golding, 1948). There are published reports of damage by this species to maize and millet (Descamps, 1954), sorghum (Joyce, 1952), tobacco (Zacher, 1921) and some other plants.

DISCUSSION. *G. africanus orientalis* was based on material from India and Sri Lanka which does not differ morphologically from African specimens and the name is therefore synonymised. Sjöstedt (1928: 50) clearly designated one female from Sri Lanka, deposited in the MHN, Geneva, as the holotype. The female from Darjeeling in the NR, Stockholm labelled 'Typus' cannot therefore be the holotype.

Specimens from Simla, India wrongly determined by Sjöstedt (1928: 26) as *Gastrimargus minor* belong to *G. a. sulphureus*. *G. marmoratus* var. *minor* (Saussure, 1888: 39), described from Mongolia, is a *nomen incertae sedis* since no species of *Gastrimargus* is otherwise known from there and the original material of *minor* is lost. Saussure was familiar with *Oedaleus infernalis* from Mongolia and it is possible that it was this species that he was considering under the name *G. marmoratus* var. *minor*.

G. parvulus Sjöstedt is the most easterly race of *G. africanus* and is here retained as a subspecies. Sjöstedt described the green morph as *G. parvulus* and the brown morph as *G. pusillus*, a separate species. With the prerogative of first reviser *parvulus* is regarded as the senior synonym despite the line priority of *pusillus* (Sjöstedt: 1928: 38), since only *G. parvulus* has a precise type-locality.

The measurements of *G. africanus sulphureus* and *G. africanus parvulus* are generally much smaller than those of *G. africanus africanus*. Specimens of *G. africanus* from central Thailand are intermediate both in size and coloration between *G. a. parvulus* and the nominate subspecies. They may or may not show some degree of blue pigmentation on the underside of the hind femur and reduction in the intensity of the yellow colour of the hind wing basal area. The shorter wings and darker colour of *G. a. sulphureus* are presumably a response to high altitude. Genitalia differences within this highly variable species will not become clear until more material from a greater range of localities is available for study.

Key to subspecies of *G. africanus*

1 Hind femur with interior ventral surface suffused with blue-grey to blue-black in basal half . . 2
– Hind femur ventrally straw-coloured, without blue pigment (E. China, Hong Kong, Vietnam, Burma, Thailand, Java, Kangean Is.) . . . . . ***G. africanus parvulus*** Sjöstedt (p. 251)
2 Tegmen surpassing hind knees by one-quarter to one-third of hind femur length. General coloration sombre; basal pale transverse band of tegmen partially or completely obsolete; hind wing basal area pale yellow or greenish yellow, not bright yellow. Subapical ventral process of aedeagus pronounced in lateral view (Fig. 3) (Pakistan, India (Uttar Pradesh, Punjab), Nepal) ***G. africanus sulphureus*** Bei-Bienko (p. 250)
– Tegmen surpassing hind knees by one-third to one-half of hind femur length. General coloration more vivid; pale bands of tegmina distinct; hind wing basal area bright yellow. Subapical ventral process of aedeagus weak in lateral view (Fig. 2) 3
3 Tegmen short, usually less than 27·5 mm ♂, 36·0 mm ♀; TL/PL ratio less than 3·9 ♂, 4·2 ♀. Metazona of pronotum with posterior arms of ×-marking usually visible and with several indistinct pale striae extending obliquely outwards and backwards on each side of median carina (Madagascar) . . . . . ***G. africanus madagascariensis*** Sjöstedt (p. 250)
– Tegmen longer, usually more than 25 mm ♂, 37 mm ♀; TL/PL ratio more than 3·9 ♂, 3·8 ♀. Metazona of pronotum with ×-marking usually effaced and without pale striae. (Africa, Arabia, India) . . . . . ***G. africanus africanus*** (Saussure) (p. 248)

Gastrimargus africanus africanus (Saussure, 1888)

Oedaleus (*Gastrimargus*) *marmoratus* var. *africana* Saussure, 1888: 39. LECTOTYPE ♂, South Africa (MHN, Geneva), here designated [examined].

Gastrimargus africanus (Saussure) Kirby, 1910: 227.

Gastrimargus africanus var. *zebrata* Sjöstedt, 1928: 41. Holotype ♀, Tanzania (NR, Stockholm) [examined]. [Synonymised by Dirsh, 1966: 426.]

Gastrimargus africanus var. *orientalis* Sjöstedt, 1928: 41. Holotype ♀, Sri Lanka (MHN, Geneva) [examined]. **Syn. n.**

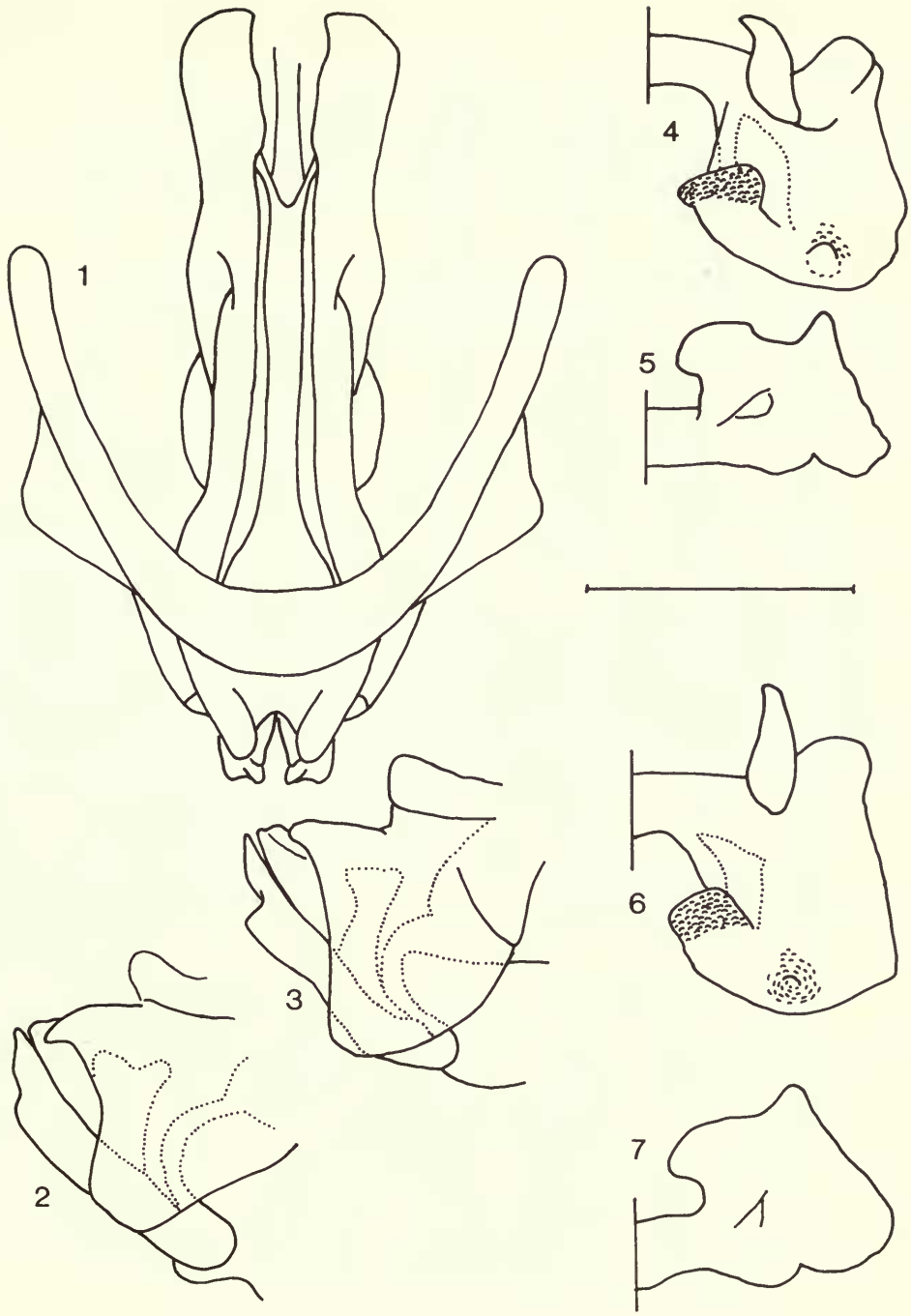
Measurements

Sample from Tanzania.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	38·23	5·01	7·08	29·18	16·93	3·88	4·37	4·12
Range	33·1–43·3	4·5–5·7	6·2–8·1	25·1–32·5	14·2–19·4	3·3–4·3	4·0–4·9	3·9–4·5
S.D.	2·076	0·270	0·412	1·543	1·104	0·204	0·170	0·150
n	30	30	26	30	30	30	30	26
Females								
Mean	53·36	7·12	9·82	40·56	23·59	5·48	4·31	4·14
Range	48·7–58·5	6·6–7·7	9·0–10·9	37·2–44·7	20·6–25·9	4·9–5·9	4·0–4·7	3·8–4·6
S.D.	2·284	0·270	0·447	1·952	1·291	0·225	0·155	0·195
n	30	30	28	30	30	30	30	28

Material examined

Gastrimargus marmoratus var. *africana* Saussure, lectotype ♂, **South Africa**: Cape of Good Hope (MHN, Geneva). *Gastrimargus africanus* var. *zebrata* Sjöstedt, holotype ♀, **Tanzania**: Mt Kilimanjaro (NR, Stockholm). *Gastrimargus africanus* var. *orientalis* Sjöstedt, holotype ♀, **Sri Lanka**, no further data (MHN, Geneva).



Figs 1–7 *Gastrimargus africanus*, genitalia. 1, *G. a. africanus*, phallic complex, dorsal view; 2, same, posterior portion, lateral view; 3, same, *G. sulphureus*; 4, *G. a. africanus*, epiphallus, right half, dorsal view; 5, same, posterior view; 6, *G. a. sulphureus*, epiphallus, right half, dorsal view; 7, same, posterior view.

In addition to the type-material listed above, 1126 specimens of this subspecies were examined from the following countries: **Sierra Leone, Mali, Niger, Ghana, Nigeria, Togo, Pigalu** (Annobón), **Principé I., São Tomé I., Cameroun, Central African Republic, Libya, Sudan, Ethiopia, Congo, Zaire, Uganda, Rwanda, Burundi, Kenya, Angola, Zambia, Malawi, Tanzania, Zimbabwe, Mozambique, South Africa, Swaziland, Comoro Is., Seychelles, Saudi Arabia, Yemen, Pakistan, India** (including 1 ♀, Sikkim, E. Himalayas, Kurseong, 1900 m, 14. viii. 1909 (*Jenkins*); 1 ♂, Balugaon, Puri distr., Orissa, 21–23.vii.1913 (*Annandale*); 1 ♀, Darjeeling, 29.xi.1904 (*Gulmann*) (NR, Stockholm) [all three specimens paratypes of *Gastrimargus africanus* var. *orientalis* Sjöstedt, the Darjeeling specimen incorrectly labelled 'Typus']), **Sri Lanka** (including 1 ♀, no locality data (*Green*) [figured in error as '*G. transversus*' by Kirby, 1914: 145]; 1 ♂, no data (*Humbolt*) (MHN, Geneva) [allotype of *Gastrimargus africanus orientalis* Sjöstedt]), **Nepal, Tibet, Burma, Thailand**.

Gastrimargus africanus madagascariensis Sjöstedt, 1928 **subsp. rev.**

Gastrimargus africanus var. *madagascariensis* Sjöstedt, 1928: 41. Holotype ♀, MADAGASCAR (NR, Stockholm) [examined]. [Incorrectly synonymised by Dirsh, 1963: 273.]

MEASUREMENTS

Sample from Madagascar.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	32·28	4·56	6·76	24·37	16·42	3·66	4·49	3·63
Range	29·1–36·0	4·1–5·0	6·1–7·4	21·8–27·4	15·2–17·9	3·3–4·0	4·2–4·9	3·3–3·9
S.D.	1·477	0·207	0·312	1·178	0·661	0·170	0·168	0·164
n	29	29	25	29	25	25	25	25
Females								
Mean	43·60	6·33	9·04	32·50	21·58	4·96	4·35	3·59
Range	39·5–47·6	5·8–6·9	8·0–10·0	29·3–35·6	18·7–23·4	4·2–5·6	3·9–4·6	3·3–4·2
S.D.	2·320	0·263	0·542	1·864	1·118	0·269	0·176	0·175
n	33	39	38	36	38	38	38	35

MATERIAL EXAMINED

Gastrimargus africanus var. *madagascariensis* Sjöstedt, holotype ♀, **Madagascar**: Tananarive (NR, Stockholm).

Madagascar: 18 ♂, 14 ♀, Tananarive, Namsana, 25.vii.–26.ix.1928 (*Zolotarevsky*); 7 ♀, Vohimarina, Tongobory, Tulear, 2.i.1928 (*Zolotarevsky*); 1 ♀, Andranoabo, Betioky, Tulear, 8.ii.1928 (*Zolotarevsky*); 1 ♀, Andranolava, Tongobory, Tulear, 27.xii.1927 (*Zolotarevsky*); 1 ♂, 2 ♀, Ejeda, Betioky, Tulear, 16.ii.1928 (*Zolotarevsky*); 1 ♀, Maroroky, Ankajoah, 17.xii.1927 (*Zolotarevsky*); 2 ♀, Manera, Tulear, 15.xii.1927 (*Zolotarevsky*); 4 ♀, no data; 2 ♂, Sakamena, Betioky, 15.v.1928 (*Zolotarevsky*); 3 ♀, Sainta, Betroka, 14.v.1928 (*Zolotarevsky*); 1 ♂, Ambohimitombo forest, 24.i.1895 (*Forsyth Major*); 1 ♀, Tananarive, 8.x.1970 (*Hammond*); 1 ♂, no data (*Zolotarevsky*); 2 ♀, Tserazafy, Valala-Advisa-Syakita, 12.viii.1913 (*Beck*); 2 ♂, Arivonimamo, 3.viii.1913 (*Beck*); 1 ♂, Tsiafakomboa, 'Aketa', 4.viii.1913 (*Beck*); 1 ♀, Tsiafakomboa, 'Advisa', 4.viii.1913 (*Beck*); 1 ♂, Soafoy, 1400 m, 15.viii.1913 (*Beck*); 1 ♂, Amboniriana, Fsikovodrindrina, 26.viii.1913 (*Beck*); 1 ♂, Antanety, Aketa, 17.ix.1913 (*Beck*); 1 ♀, Ambohibelo, 1280 m, 3.viii.1913 (*Beck*); 4 ♀, Sikora, (MHN, Geneva); 6 ♀, Tananarivo (MHN, Geneva); 1 ♂, no data (MHN, Geneva).

Gastrimargus africanus sulphureus Bei-Bienko, 1951 **stat. n.**

Gastrimargus sulphureus Bei-Bienko, 1951: 580. Holotype ♂, PAKISTAN (ZI, Leningrad) [examined].

[*Gastrimargus minor* (Saussure); Sjöstedt, 1928: 26. Misidentification, referred to *G. sulphureus* by Bei-Bienko, 1951: 580.]

MEASUREMENTS
Sample from India, Pakistan and Nepal.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	30·62	4·59	6·03	22·46	15·29	3·79	4·04	3·72
Range	26·8–33·3	4·1–4·9	5·5–6·5	19·1–24·6	13·3–16·5	3·2–4·1	3·8–4·2	3·4–4·1
S.D.	1·478	0·184	0·329	1·212	0·773	0·216	0·134	0·191
n	17	18	16	18	15	15	15	16
Females								
Mean	42·36	6·73	8·59	30·89	21·78	5·46	4·00	3·55
Range	37·2–47·5	6·0–7·9	7·3–9·7	26·7–35·5	19·3–25·1	4·6–6·9	3·4–4·2	3·3–4·2
S.D.	3·012	0·521	0·711	2·529	1·800	0·578	0·177	0·225
n	12	15	15	13	15	15	15	13

MATERIAL EXAMINED

Gastrimargus sulphureus Bei-Bienko, holotype ♂, **Pakistan**: Baluchistan, Ziarat, 2400 m, 6.viii.1929 (*Evans*) (ZI, Leningrad).

Pakistan: 1 ♀, Baluchistan, Ziarat, 2400 m, 1–15.viii.1930, 1 ♀, same data, 20.ix.1930; 1 ♂, Baluchistan, Urak valley, 26 km from Quetta, 2100 m, 8.vi.1930; (*Evans*); 1 ♂, 4 ♀, Baltistan; 1 ♂, Hunza, 2250 m, 27.viii.1913 (*Hingston*); 3 ♂, Achhebal, 21–24.ix.1923 (*Dutt*); 1 ♂, 2 ♀, Perimahal, nr Srinagar, 10.x.1923 (*Fletcher*). **India**: 3 ♂, 1 ♀, NW. India; 1 ♀, Uttar Pradesh, Garhwal (*Longstaff*); 2 ♂, Punjab, Simla, 2500 m, vii. (MNHU, Berlin); 1 ♂, 1 ♀, Punjab, Simla, 2500 m, vii. (NR, Stockholm); 1 ♂, 3 ♀, same but undated (NR, Stockholm); 1 ♀, Kandaghat, Simla hills, 1050–1380 m, viii.1925 (*Chopra*); 1 ♂, Aeni [?], Simla hills, 1050–1200 m, in jungle, viii–ix.1925 (*Chopra*); 2 ♂, Simla, 1950–2100 m, 2.ix.25 (*Whistler*). **Nepal**: 1 ♂, Nagarkot, 2100 m, 6.vi.1937 (*Bailey*).

Gastrimargus africanus parvulus Sjöstedt, 1928 **stat. n.**

Gastrimargus parvulus Sjöstedt, 1928: 38. Holotype ♀, JAVA (NM, Maastricht) [examined].
Gastrimargus pusillus Sjöstedt, 1928: 38. Holotype ♀, 'Nederl. Indien' (NM, Maastricht) [examined]. **Syn. n.**

MEASUREMENTS
Sample from Thailand.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	36·83	5·09	6·94	27·83	17·55	4·09	4·19	4·01
Range	32·9–40·0	4·7–5·5	6·2–7·6	24·4–30·0	15·3–18·6	3·6–4·5	3·9–4·6	3·5–4·3
S.D.	1·710	0·208	0·405	1·333	0·821	0·210	0·162	0·193
n	33	35	33	33	33	33	33	31
Females								
Mean	51·52	7·35	9·48	38·79	23·92	5·83	4·11	4·09
Range	47·0–54·7	6·8–7·9	8·9–10·6	35·0–41·8	22·1–26·5	5·4–6·3	3·9–4·4	3·7–4·4
S.D.	1·825	0·252	0·384	1·697	1·304	0·261	0·147	0·192
n	20	20	19	20	19	19	19	19

Sample from Java.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	28·30	4·05	5·47	21·07	13·80	3·25	4·20	3·85
Range	28·1–28·4	3·9–4·2	5·4–5·6	20·8–21·4	13·8–13·8	3·2–3·3	4·1–4·3	3·8–3·9
S.D.	—	—	—	—	—	—	—	—
n	2	2	2	2	2	2	2	2
Females								
Mean	42·98	5·93	7·71	31·95	19·38	4·76	4·07	4·12
Range	38·8–48·5	5·4–7·0	6·9–8·8	28·3–37·1	17·0–22·6	4·3–5·5	3·8–4·4	3·9–4·4
S.D.	2·675	0·366	0·505	2·500	1·578	0·318	0·160	0·154
n	12	16	16	14	15	15	15	14

MATERIAL EXAMINED

Gastrimargus parvulus Sjöstedt, holotype ♀, **Java**: Mt Merbaboe, 1500 m, ix.1916 (*Roepke*) (NHM, Maastricht). *Gastrimargus pusillus* Sjöstedt, holotype ♀, **Java** [?]: 'Ned. Oost Indie', no further data (NHM, Maastricht).

Java: 4 ♀, West Java, Mt Gede, 1200 m, viii.1892 (*Fruhstorfer*) (IRSNB, Brussels); 1 ♂, 1 ♀, Semarang, 1936 (*Le Moult*) (NHM, Maastricht); 1 ♀, Buitenzorg, 1939 (*Blizdorp*) (NHM, Maastricht); 1 ♀, Djember, iii.1935 (NHM, Maastricht); 1 ♀, Ond., Herboth Bodja, 350 m, 11.i.1941 (*Dupont*) (NHM, Maastricht); 1 ♂, Ond., Tjogreg Buitenzorg, 12.v.1940 (*Wira*) (NHM, Maastricht); 1 ♀, Bogor, 1.xi.1965 (*Stusak*) (BPBM, Honolulu); 1 ♀, Passoeroean, iv.1914 (*Muir*) (BPBM, Honolulu); 1 ♀, no data (*Fruhstorfer*) (MNHN, Paris); 1 ♀, Buitenzorg, 1931 (*Windred*) (ANIC, Canberra). **Kangean Is.**: 1 ♀, Ardjasa I., 17.viii.1954 (*Hoogenvert*) (NHM, Maastricht). **Thailand**: 18 ♂, 5 ♀, Chaibadal, Lopburi, 26.vii.1966 (*Prasartthai*); 1 ♂, 1 ♀, Chonburi, 19.vi.1961 (*Prachua*); 1 ♂, Bang Sue, Bangkok, 20.x.1955 (*Ruchair*); 1 ♀, Soi Ari, Bangkok, 10.vii.1957 (*Student*); 1 ♂, Saraburi, 5.viii.1959 (*Montean*); 1 ♂, Saraburi, 28.viii.1959 (*Sirichai*); 1 ♀, Saraburi, 13.vi.1957 (*Student*); 2 ♂, Nakhonratchasima, 30.vi.1962 (*Phon*); 1 ♂, same data, 4.viii.1964 (*Aroon*); 1 ♀, Muakleg, Nakhonratchasima, 18.viii.1955 (*Suphar*); 1 ♂, same locality, 10.vii.1954 (*Student*); 1 ♀, Dhonburi, 27.iv.1959 (*Prayong*); 1 ♀, Komaiasai, Kalasindhi, 2.viii.1949 (*Chainarouf*); 2 ♀, Lopburi, 4.ix.1963 (*Aroon*); 1 ♀, Udon, 1.viii.1964 (*Chanchai*); 3 ♂, Ubol, 1.viii.1958 (*Phon*); 2 ♂, same data, 1.viii.1955 (all DA, Bangkok). **Burma**: 7 ♂, 1 ♀, Mt Victoria, Chin hills, 1000 m, vi.1938 (*Heinrich*) (MNHU, Berlin). **Vietnam**: 1♀, Annam, Langbian Prov., Dran, 900 m, iii–iv.1918 (*Boden Kloss*). **Hong Kong**: 6 ♂, 1 ♀, New Territories, Shatin, 28.i.1977 (*Winney*) (AFD, Hong Kong). **China**: 3 ♀, Fujian, Guangze, 10–25.ix.1937 (*Klapperich*) (MNHU, Berlin); 4♀, Yunnan, 'Sannen Kai', (IRSNB, Brussels); 1 ♀, Yunnan, 'nr Chi-Tien', 2100 m (*Gregory*); 1 ♂, Yunnan, 'Feng-Ming-Kai', S. of Lijiang, 2300 m, 9.viii.1922 (*Gregory*); 1 ♂, Yunnan, 'Tacheng Chi-Tsung R.', 2200 m, open valley, 1.viii.1922 (*Gregory*); 1 nymph, same data, 1.vii.22; 1 ♂, Hainan, 'You Boi', 2.vi.1903; 1 ♂, Hainan, Wuzhi Shan, 15.v.1903; 1 ♂, Jiangxi, 10.viii.1924 (*Chang*); 1 ♂, Guangdong, 'Linchow', Linxian distr., 9.viii.1934 (*To*); 1 ♀, Guangdong, Zhongdong, Shangshui, Linxian distr. (*To*).

Gastrimargus nubilus Uvarov, 1925

(Figs 8–11, 117, 123)

Gastrimargus nubilus Uvarov, 1925*a*: 325. Holotype ♂, CHINA (BMNH) [examined].

Gastrimargus africanus chinensis Willemse, 1933: 15. LECTOTYPE ♂, CHINA (IP, Eberswalde), here designated [examined]. [Synonymised by Uvarov, 1939: 564.]

DIAGNOSIS. Fastigium of vertex flat or slightly concave. Pronotum with median carina arcuate, not intersected by posterior sulcus; dorsum smooth; hind margin acutangular. Tegmen reduced, surpassing folded hind knees by one-fifth of hind femur length in male, hardly at all in female. Genitalia (Figs 8–11): similar to *G. africanus*.

Coloration variable, generally more sombre than *G. africanus*. Pronotal ×-marking often indistinct (Fig. 123). Tegmen with pale cross-banding reduced to one or two variable pale patches on costal margin, two- and four-sevenths along from base (Fig. 123). Hind wing with complete fascia (Fig. 123) and with apical half of wing beyond fascia infumate (less distinctly in female); basal area of wing pale greenish yellow. Hind femur as in *G. africanus africanus*, interior ventral surface blue-black. Hind tibiae red.

MEASUREMENTS

Sample from China: Yunnan.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	29·03	4·62	6·10	21·04	15·63	3·50	4·47	3·48
Range	26·6–31·4	4·3–4·9	5·5–6·5	19·3–22·6	14·0–17·1	3·2–3·7	4·2–4·7	3·3–3·7
S.D.	1·200	0·175	0·298	0·841	0·942	0·232	0·128	0·107
n	14	14	9	14	12	12	12	9
Females								
Mean	36·49	6·54	8·19	25·63	20·44	4·97	4·12	3·19
Range	28·9–40·4	5·3–7·1	6·7–9·3	20·1–28·7	19·5–22·9	3·6–5·4	3·9–4·4	3·0–3·6
S.D.	2·711	0·398	0·758	2·060	1·769	0·447	0·139	0·190
n	14	15	11	14	12	12	12	10

AFFINITIES. The range of this species overlaps with *G. africanus*, a species which it closely resembles and from which it has presumably been derived by the process of adaptation to harsh montane conditions.The reduction of tegmen and wing length, loss of the bright yellow basal area of the hind wing, and darkening of the apical half of the wing are all recurring features of this process. Similar characteristics are found in many montane Oedipodinae, as for example in *G. willemsei* (p. 303).

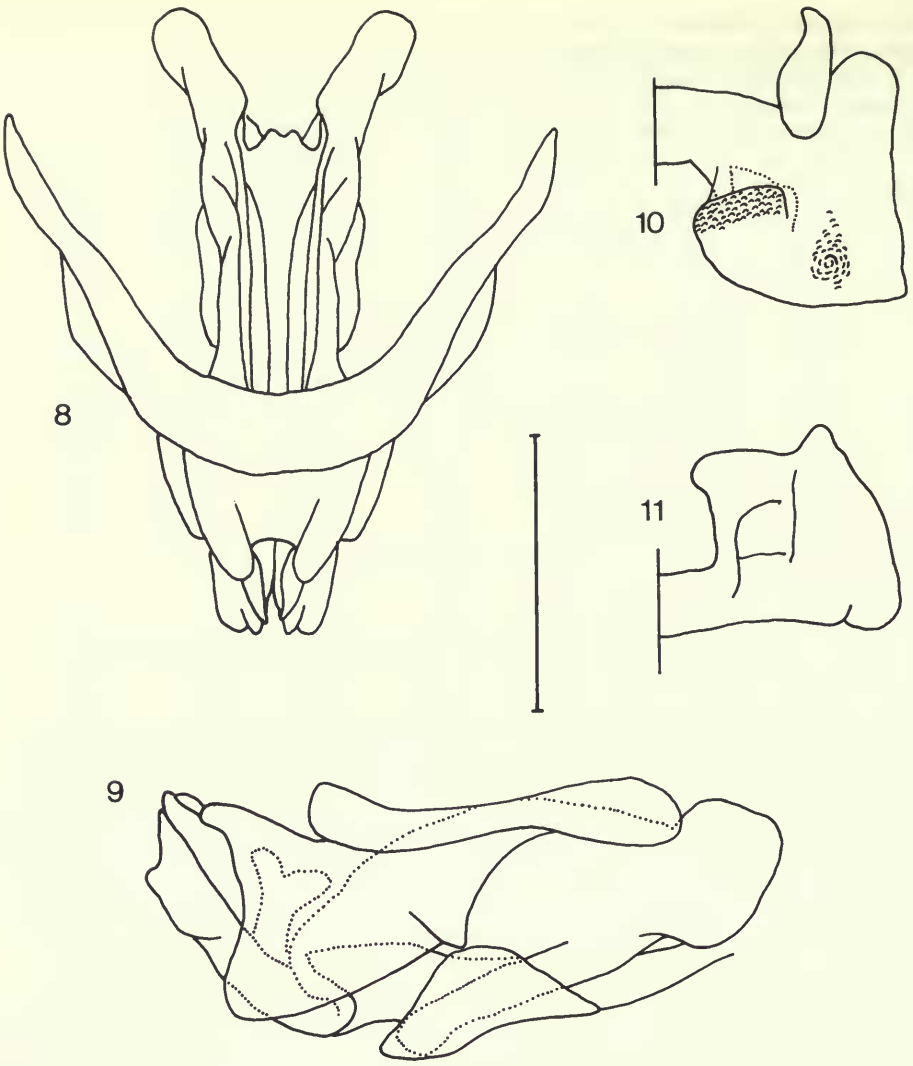
MATERIAL EXAMINED

Gastrimargus nubilus Uvarov, holotype ♂, **China**: Yunnan, Dazheng, 2200 m, 1.viii.1922 (*Gregory*) (BMNH). *Gastrimargus africanus chinensis* Willemse, lectotype ♂, **China**: Sichuan, Zaji distr., 'Tatsienlu', 7.vii.1930 (*Friedrich*) (IP, Eberswalde).

China: 5 ♂, 14 ♀, Sichuan, Zaji distr., Kangding, 7.viii.1930 (*Friedrich*) (IP, Eberswalde) (paralectotypes of *G. africanus chinensis*); 1 ♂, same data (paralectotype of *G. africanus chinensis*); 4♀, same data, 30.ix.1930 (IP, Eberswalde) (paralectotypes of *G. africanus chinensis*); 1 ♀, same data, 22.vii.1930 (IP, Eberswalde) (paralectotypes of *G. africanus chinensis*); 1 ♀, same data (paralectotypes of *G. africanus chinensis*); 1 ♂, 1 ♀, same data, 7.ix.1930 (paralectotype of *G. africanus chinensis*); 1 ♂, Yunnan, Gadya, 1980 m, 4.viii.1922 (*Gregory*) (paratype of *G. nubilus*); 1 ♂, Yunnan, 'Sekan', 'Jugeh R.', 2200 m, 30.vii.1922 (*Gregory*) (paratype of *G. nubilus*); 1 ♀, W. Yunnan, 'Talifu', viii.–ix.1914, 2200 m (*Mell*) (MNHU, Berlin); 1 ♀, label illegible, 1.viii. (*Mell* ?) (MNHU, Berlin); 1 ♂, label illegible, 'Yangwong' [?], 'Tafuken-Pupeng' [?], 26.vii.1914 (*Mell* ?) (MNHU, Berlin); 2 ♂, no further data (*Mell*) (MNHU, Berlin); 9 ♂, 13 ♀, Yunnan, 'Sannen Kai', (IRSNB, Brussels); 1 ♂, 1 ♀, E. Tibet, Dzogang, 2700–3600 m, 13–21.ix.1936 (*Kaulback*); 1 ♀, E. Tibet, Poshe, 2700–3600 m, 12–28.viii.1936 (*Kaulback*).

DISTRIBUTION (Fig. 117, and Biogeography section, p. 314). *G. nubilus* is a montane species endemic to the mountains of southern China, north of the Burma border.

DISCUSSION. The syntype series of *G. africanus chinensis* Willemse originally consisted of 31 males and 55 females. Of these 1 male and 2 females are now in the BMNH, London, and all or most of the remainder are in the IP, Eberswalde. A male from the latter collection is here designated as the lectotype, and the remaining specimens as paralectotypes.



Figs 8–11 *Gastrimargus nubilus*, genitalia. 8, phallic complex, dorsal view; 9, same, lateral view; 10, epiphallus, right half, dorsal view; 11, same, posterior view.

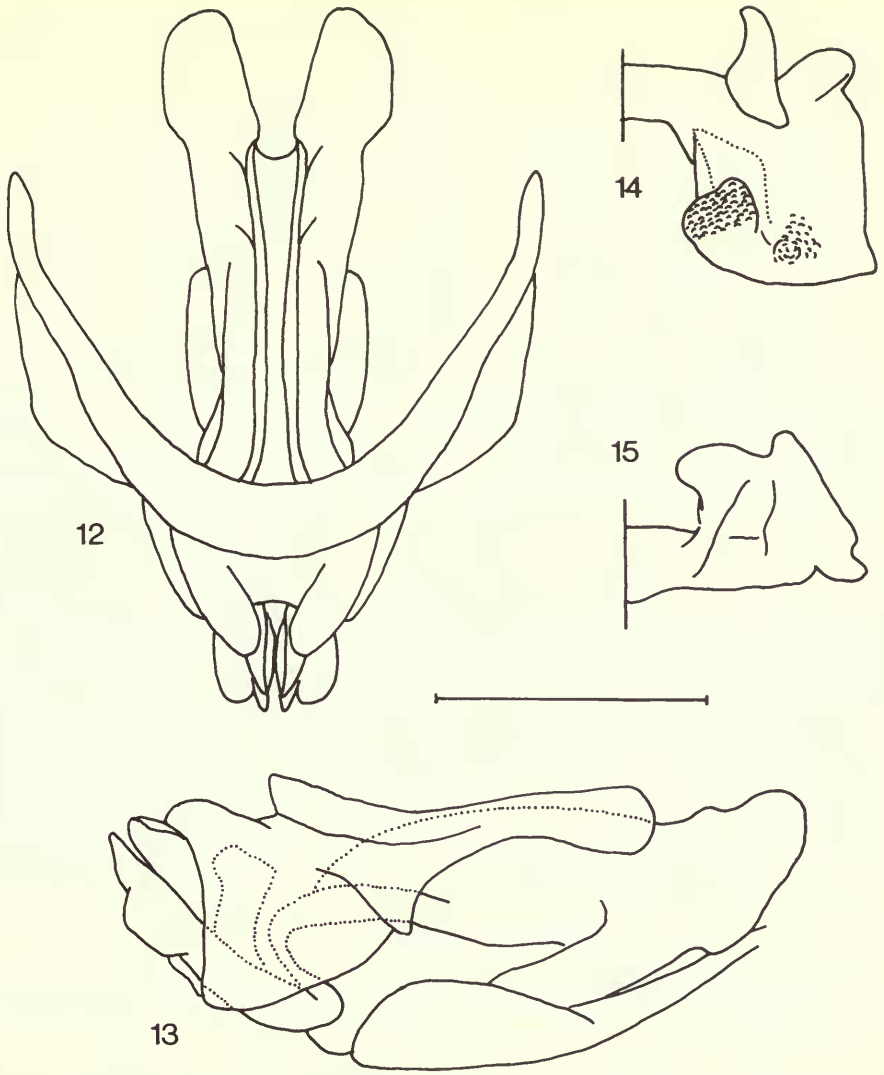
Gastrimargus lombokensis Sjöstedt, 1928

(Figs 12–15, 118, 124)

Gastrimargus lombokensis Sjöstedt, 1928: 6, 12. Holotype ♀. LOMBOK (MNHU, Berlin) [examined].
Gastrimargus lumbokensis [sic] Sjöstedt, 1928: 42.
Gastrimargus floresensis Sjöstedt, 1928: 43. Holotype ♂, FLORES (MNHU, Berlin) [lost]. **Syn. n.**

DIAGNOSIS. Fastigium of vertex convex. Pronotum as in *G. africanus*, not intersected by posterior sulcus; hind margin rectangular to slightly acutangular. Tegmen surpassing folded hind knees by about one-third of hind femur length. Genitalia (Figs 12–15) similar to *G. africanus*.

Coloration similar to *G. africanus*. Hind wing basally pale yellow, and fascia narrowly interrupted between *Cu*2 and 1*A*, with anterior end of anal section noticeably incurved towards wing base along 2*A* (Fig. 124). Hind femur as in *G. africanus* externally; internal surface pale red, sometimes partly obscured by variable dark patch in medial area; dark pigment sometimes absent in green morphs except for rows of black dots on carinulae; ventral surface pale red. Hind tibiae orange-red in male becoming paler on outer sides, duller in female.



Figs 12–15 *Gastrimargus lombokensis*, genitalia. 12, phallic complex, dorsal view; 13, same, lateral view; 14, epiphallus, right half, dorsal view; 15, same, posterior view.

MEASUREMENTS
Sample from Lesser Sunda Is.

	Males							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	29·63	4·32	5·89	21·93	14·98	3·47	4·32	3·75
Range	26·1–33·5	3·9–4·8	5·1–7·1	19·1–24·9	13·2–17·0	3·1–3·9	4·0–4·7	3·2–4·2
S.D.	1·847	0·245	0·481	1·442	0·814	0·185	0·160	0·234
n	36	36	36	36	34	34	34	36

MEASUREMENTS—(*cont.*)

	Females							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	38·90	6·04	7·77	28·29	19·95	4·72	4·23	3·65
Range	33·6–43·3	5·3–6·9	6·3–9·3	22·1–32·0	16·5–22·8	4·2–5·4	3·8–4·5	2·7–4·0
S.D.	2·490	0·414	0·636	2·162	1·451	0·284	0·161	0·241
n	35	37	37	36	35	35	35	36

AFFINITIES. *G. lombokensis* occupies a geographical and taxonomic position intermediate between *G. africanus* in Java and *G. musicus* in New Guinea. The male genitalia with their rather short aedeagus are closer to those of *G. africanus* than to *G. musicus*, but the red underside of the hind femur is a character found also in *G. subfasciatus* on neighbouring Timor and *G. musicus* in New Guinea and Australia. However, the form of the hind wing band is peculiar to this species (Fig. 124), suggesting that *G. lombokensis* was not an intermediate stage in the evolution of *G. musicus*.

MATERIAL EXAMINED

Gastrimargus lombokensis Sjöstedt, holotype ♀, **Lombok**: 1 ♀, Sambalun, 1200 m, iv.1896 (*Fruhstorfer*) (MNHU, Berlin). **Kangean Is.**: 1 ♀, Sepandjang I., 9.xi.1959 (*Hoogerwert*) (NHM, Maastricht). **Lombok**: 3♂, 9 ♀, Narmada, 14–18.iii.1927 (*Rensch*) (MNHU, Berlin); 1 ♂, 3 ♀, Sembalun, 1200 m, 30–31.iii.1927 (*Rensch*) (MNHU, Berlin); 1 ♂, 1 ♀, Ekas, 17–20.iv.1927 (*Rensch*) (MNHU, Berlin); 3 ♀, Swela, 3450 m, 22–27.iii.1927 (*Rensch*) (MNHU, Berlin); 1 ♂, Ampenan, iii.1940 (NHM, Maastricht); 1 ♂, Sapit, 600 m, iv.1896 (*Fruhstorfer*) (MHN, Geneva); 2 ♀, Sambalun, 1200 m, iv.1896 (*Fruhstorfer*) (MHN, Geneva). **Sumbawa**: 4 ♂, 3 ♀, Besar, 24.iv.–2.v.1927 (*Rensch*) (MNHU, Berlin); 3 ♂, 2 ♀, Dompu, 2–4.vi.1928 (*Rensch*) (MNHU, Berlin); 1 ♀, same data (BMNH); 1 ♀, Wawo, Südl. d., Maria-Gebirges, 450 m, 2–4.vi.1927 (*Rensch*) (MNHU, Berlin); 1 ♂, 1 ♀, same data (BMNH). **Sumba**: 1 ♂, Prai Jawang, Rende Wai, 13.vi.1949 (*Bühler & Sutter*). **Flores**: 2♂, 4 ♀, Ruteng, x.–xii.1968 (*Verheyen*) (NHM, Maastricht); 1 ♂, 1 ♀, Larantuka (*Semmelink*) (MNHU, Berlin); 1 ♂, 1 ♀, Rana Mêsé, 20–30.vi.1927 (*Rensch*) (MNHU, Berlin); 11 ♂, 6 ♀, Endeh, 10–16.vi.1927 (*Rensch*) (MNHU, Berlin); 2 ♂, same data (BMNH).

DISTRIBUTION (Fig. 118, and Biogeography section, p. 315). Lesser Sunda Is.

DISCUSSION. Despite the loss of the unique holotype male of *G. floresensis*, the above synonymy is confirmed both by Sjöstedt's description and plate (1928: 43), and by examination of new material from Flores.

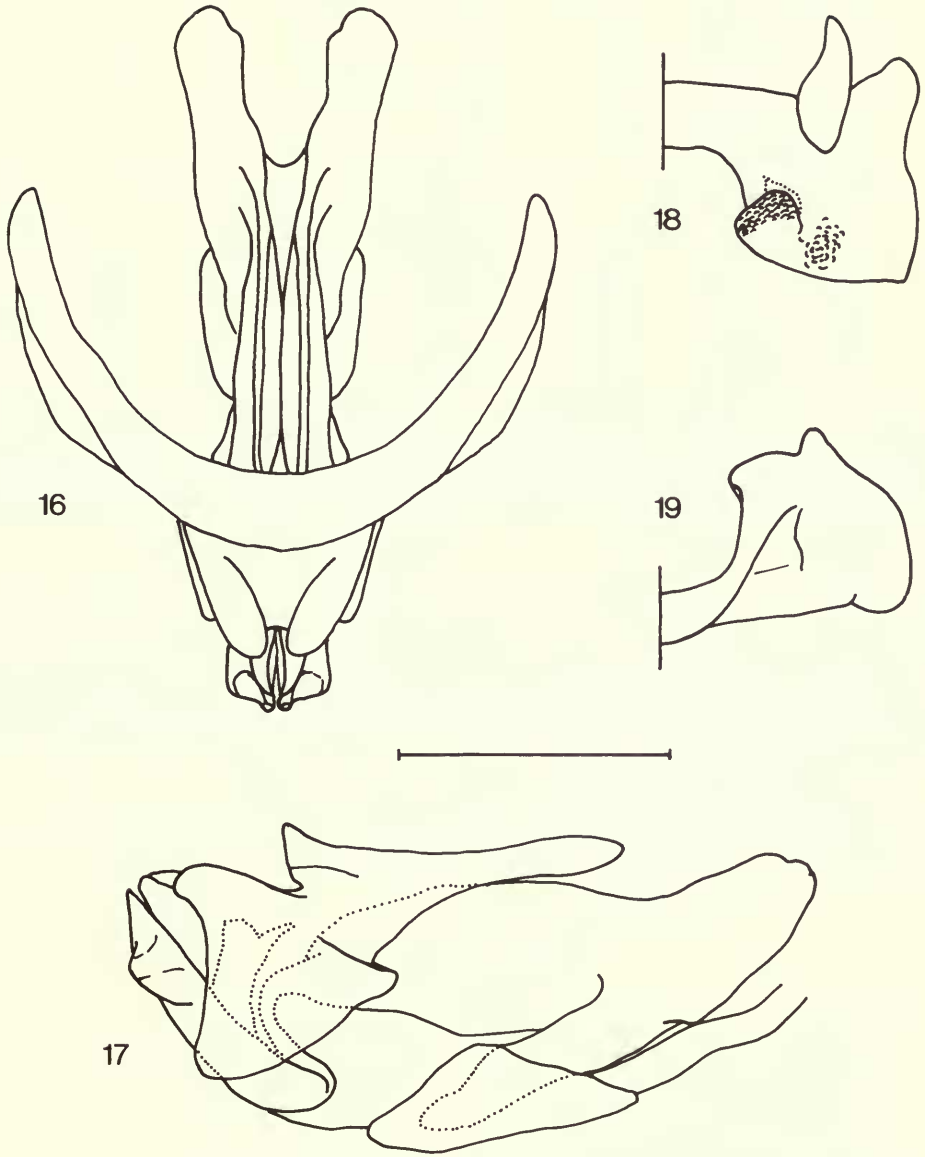
Gastrimargus subfasciatus (de Haan, 1842)

(Figs 16–19, 120, 125)

Acridium (*Oedipoda*) *subfasciatum* de Haan, 1842: 161. LECTOTYPE ♂, TIMOR (RNH, Leiden), here designated [examined].
Oedaleus (*Gastrimargus*) *subfasciatus* (de Haan) Saussure, 1884: 115; 1888: 39 [gives incorrect type-locality].
Gastrimargus subfasciatus (de Haan) Willemse, 1928: 14

DIAGNOSIS. Antennae long, in male 1·25 times combined length of head and pronotum. Fastigium of vertex flat or slightly concave. Pronotum with median carina arcuate, not intersected by posterior sulcus; hind margin slightly acutangular. Tegmen surpassing folded hind knees by about one-third of hind femur length. Genitalia (Figs 16–19) similar to *G. africanus*.

Coloration similar to *G. africanus*. Metazona of pronotum often with dark brown diamond-shaped area in male, reduced in female to two dark bars flanking median carina on inner sides of posterior arms of ×-marking; ×-marking often indistinct. Tegmen similar to *G. africanus*. Hind wing basally pale blue; fascia interrupted, restricted to posterior margin of wing, not advancing further than 3*A* (Fig. 125). Hind femur externally as in *G. africanus*, internally with dark brown patch in basal half of medial area; lower internal carinula and ventral surface of hind femur bright red in male, duller in female. Hind tibiae of male bright orange-red on internal lateral surface, paler on outer surface, less pronounced in female.



Figs 16–19 *Gastrimargus subfasciatus*, genitalia. 16, phallic complex, dorsal view; 17, same, lateral view; 18, epiphallus, right half, dorsal view; 19, same, posterior view.

MEASUREMENTS
Sample from Timor.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	30·61	4·32	6·15	22·74	14·87	3·52	4·20	3·70
Range	28·2–33·6	4·0–5·0	5·5–6·7	21·0–24·7	13·1–16·7	2·6–4·0	4·0–5·3	3·4–4·0
S.D.	1·700	0·307	0·385	1·270	1·311	0·407	0·406	0·144
n	10	10	10	10	10	9	9	10
Females								
Mean	42·04	6·22	8·39	31·33	19·92	4·93	4·04	3·77
Range	37·6–45·1	5·6–6·8	7·0–9·8	27·7–34·5	17·6–21·7	4·4–5·3	3·7–4·4	3·2–4·2
S.D.	2·087	0·310	0·524	1·784	1·174	0·255	0·172	0·201
n	28	30	28	28	22	22	22	26

AFFINITIES. *G. subfasciatus* is closely allied to *G. lombokensis* on the basis of its genitalia and general appearance, particularly the red undersides of the hind femora. The greatly reduced hind wing fascia and the pale blue basal area are relatively minor modifications of the condition found in *G. lombokensis* (see Biogeography section, p. 316), despite the distinctive appearance which they present.

MATERIAL EXAMINED

Acridium (*Oedipoda*) *subfasciatum* de Haan, lectotype ♂, **Timor**: Semau I. ('Poeloe Samoe') (*Muller*) (RNH, Leiden).

Timor: 1 ♀, Semau I. (*Muller*) (paralectotype of *A. subfasciatum*) (RNH, Leiden); 1 ♂, Baucau, v–vi.1949 (*Marsden*); 4 ♂, 26 ♀, Soë (IRSNB, Brussels); 2 ♂, 2 ♀, same data (BMNH); 1 ♂, Kupang, 6–21.vi.1929 (*Mackerras*) (ANIC, Canberra); 1 ♂, same, 7–27.i.1966 (*Ferreira*) (NHM, Maastricht); 1 ♀, same, 15–30.xii.1965 (*Ferreira*) (NHM, Maastricht); 1 ♂, Roti I., Mokdale, 22.vi.1929 (*Mackerras*) (ANIC, Canberra); 3 ♀, no locality data (*Rensch*) (MNHU, Berlin).

DISTRIBUTION (Fig. 120, and Biogeography section, p. 316). Timor.

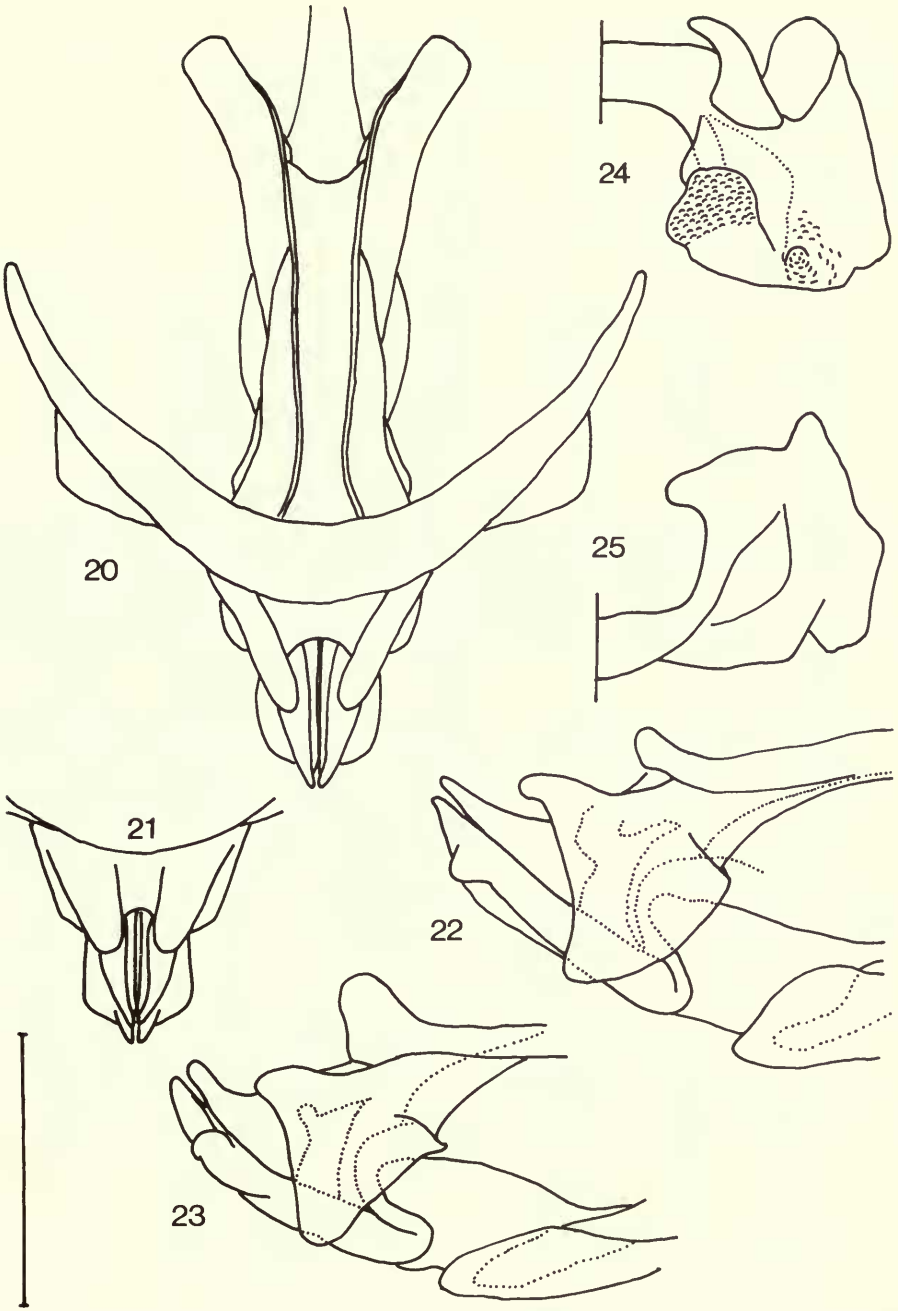
DISCUSSION. The type-material of *G. subfasciatus* in the RNH, Leiden, consists of one male, here designated lectotype, and one female, designated paralectotype.

Gastrimargus musicus (Fabricius, 1775)

(Figs 20–25, 120, 126)

Gryllus musicus Fabricius, 1775: 290. Holotype ♀, AUSTRALIA (BMNH) [examined].
Acrydium musicum (Fabricius) Olivier, 1791: 222.
Gryllus pictus Leach, 1814: 57. Type(s), AUSTRALIA (presumed lost). [Synonymy indicated by coloured plate 25 of male (?) in Leach, 1814. Synonymised by Kirby, 1910: 227.]
Gryllus stollii Leach, 1814: 137. [Unnecessary replacement name for *Gryllus pictus* Leach.]
Oedipoda musica (Fabricius) Serville, 1838: 720.
[*Locusta danica* Linnaeus; Froggatt, 1903: 1104; 1907: 41; 1910: 9. Misidentifications.]
Gastrimargus musicus (Fabricius) Kirby, 1910: 227.
Gastrimargus musicus var. *kimberleyensis* Sjöstedt, 1928: 42. Holotype ♂, AUSTRALIA (NR, Stockholm) [examined]. **Syn. n.**

DIAGNOSIS. Fastigium of vertex slightly convex, flat, or slightly concave. Pronotum with median carina arcuate, sometimes intersected by posterior sulcus; hind margin acutangular to rectangular, sharply or bluntly angled. Tegmen surpassing folded hind knees by one-quarter to one-third of hind femur length. Genitalia (Figs 20–25) with strongly projecting aedeagus and variable subapical ventral process, more strongly protruding laterally in pale wing race (E. New Guinea and Solomon Is.).



Figs 20–25 *Gastrimargus musicus*, genitalia. 20, phallic complex, dorsal view (Australia); 21, same, posterior portion (Solomon Is.); 22, same, lateral view (Australia); 23, same (Solomon Is.); 24, epiphallus, right half, dorsal view (Australia); 25, same, posterior view.

Coloration similar to *G. africanus*. Pronotal ×-marking usually indistinct, posterior arms usually obscured. Tegmen with variable cross-banding, usually distinct. Hind wing (Fig. 126) with complete fascia, sometimes narrowly interrupted between *Cu*2 and 1*A*; basal area bright yellow (Australia, central New Guinea) to pale yellow or almost colourless (E. New Guinea, Solomon Is.). Hind femur externally with or without oblique cross-banding, internally dark brown in basal half of medial area; internal ventral carinula and ventral surface red, tending to lose colour in New Guinea, usually straw-coloured in Solomon Is. Hind tibiae usually red, sometimes dull brown or straw (especially in Solomon Is.).

MEASUREMENTS

Sample from New Guinea (bright yellow winged race).

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	36·27	4·95	7·21	27·56	17·60	3·77	4·63	3·82
Range	33·5–38·9	4·5–5·3	6·6–7·9	25·3–29·3	16·2–19·4	3·2–4·1	4·3–4·9	3·4–4·1
S.D.	1·490	0·227	0·362	1·188	0·902	0·233	0·193	0·149
n	17	19	18	17	19	19	19	16
Females								
Mean	45·12	6·36	8·97	34·16	21·58	4·76	4·53	3·82
Range	42·9–47·7	6·0–6·8	8·2–10·3	32·5–36·3	19·7–24·3	4·3–5·3	4·4–4·6	3·5–4·0
S.D.	1·392	0·254	0·684	1·113	1·363	0·293	0·081	0·179
n	7	7	7	7	7	7	7	7

Sample from New Guinea (pale yellow winged race).

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	37·23	5·29	7·40	28·00	17·78	4·11	4·32	3·79
Range	34·1–41·5	4·5–6·0	6·6–8·3	25·9–31·6	15·5–20·5	3·6–4·6	4·0–4·7	3·4–4·2
S.D.	1·810	0·355	0·451	1·324	1·180	0·218	0·157	0·153
n	37	37	37	37	37	37	37	37
Females								
Mean	46·13	7·03	9·46	34·87	22·16	5·02	4·39	3·69
Range	34·5–50·3	6·2–7·7	8·8–10·5	32·3–37·8	18·7–25·4	4·1–5·8	3·6–4·9	3·3–4·0
S.D.	3·456	0·311	0·420	1·651	1·615	0·384	0·358	0·151
n	19	21	21	19	20	20	20	19

Sample from Solomon Is. (pale race).

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	37·83	5·35	7·33	28·54	18·12	4·17	4·35	3·90
Range	33·7–41·4	5·0–5·6	6·6–8·0	27·0–31·4	16·6–19·2	3·8–4·7	4·1–4·6	3·6–4·2
S.D.	1·782	0·153	0·412	1·453	0·834	0·261	0·160	0·136
n	14	14	14	14	14	14	14	14
Females								
Mean	48·19	7·01	9·21	36·06	22·48	5·20	4·33	3·90
Range	43·3–55·1	6·4–8·0	8·0–10·8	31·8–42·4	19·2–26·2	4·2–6·2	4·0–4·7	3·6–4·4
S.D.	2·943	0·380	0·593	2·336	1·457	0·391	0·202	0·171
n	24	25	25	24	25	25	25	24

AFFINITIES. *G. musicus* is allied to *G. africanus* on the basis of the yellow hind wing basal area and uninterrupted fascia, as well as the general form and coloration. The red undersides of the hind femora are common to *G. lombokensis* and *G. subfasciatus*, but *G. musicus* has a distinctly longer aedeagus than any of these species and can be differentiated by the characters given in the key (p. 246).

MATERIAL EXAMINED

Gryllus musicus Fabricius, holotype ♀, **Australia**: no further data (BMNH). *Gastrimargus musicus* var. *kimberleyensis* Sjöstedt, holotype ♂, **Australia**: Kimberley district (*Mjöberg*) (NR, Stockholm).

In addition to the types, 160 specimens were examined from the following localities. Nominate race (Australia, New Guinea). **Australia**: Tasmania, Launceston or Hobart [specimen bears both labels]; Victoria, Port Philip; New South Wales, Nowra; N.S.W., Parramatta; N.S.W., Casula; N.S.W., Shark I.; N.S.W., Port Jackson; N.S.W., Sydney; N.S.W., Clarence R.; Australian Capital Territory, Paddy's Creek; A.C.T., Thompson's Corner, nr Uriarta; A.C.T., Myponga Swamp, 80 km S. of Adelaide; Western Australia: Mundaring Weir; W.A., Albany, Mt Melville; W.A., 1 ♂, 2 ♀, Kimberley Distr. (*Mjöberg*) (paratypes of *Gastrimargus musicus* var. *kimberleyensis* labelled 'Cotypus', 1 ♂, 1 ♀ in MHN, Geneva, 1 ♀ in NR, Stockholm); Northern Territory, Port Darwin; N.T., Alexandria; N.T., Victoria R.; N.T., Van Diemen Strait; Queensland, Stanthorpe distr, Euky, Happy Valley; Q., Torres straits, Thursday I,; Q., Inkerman, nr Townsville; Q., Cardstone, nr Tully Falls; Q., Kuranda to Mareeba road, Clohesy R.; Q., Acacia Ridge, 24 km from Brisbane; Q., 21 km E. of Croydon, 150 m; Q., Bellenden Ker; Q., Rockhampton; Q., Atherton; 1 ♀, no locality data, 'one of Walker's series of *Pachytylus determinatus*'. **New Guinea**: Irian Jaya, Merauke, 8°30′S 140°22′E; Papua New Guinea, Morehead area, Western distr., 8°42′S 141°38′E, 8°43′S 141°38′E, 8°43′S 141°39′E; P.N.G., W. distr., Morehead R., Rouku; P.N.G., Rouku area, 8°39′S 141°27′E, 8°40′S 141°28′E; P.N.G., W. distr., Mabaduan, 9°17′S 142°44′E; P.N.G., W. distr., 0·5–2·0 km E. of Weam, 8°28′S 141°10′E.

Pale-wing race (E. New Guinea and Solomon Is.) **New Guinea**: Papua New Guinea, Port Moresby, Mt Lawes, 400 m; P.N.G., 14·5 km NNE. of Port Moresby, 9°22′S 147°13′E; P.N.G., Bomana War Cemetery, 14·5 km NE. of Port Moresby, 9°24′S 147°15′E; P.N.G., SE. Milne Bay; P.N.G., Goodenough Is., Milne Bay distr.; P.N.G., Raba Raba, Milne Bay distr.; P.N.G., Red Shield Farm, Central distr.; P.N.G., Central distr., Sogeri Plateau, near Iorowari, 9°27′S 147°26′E, 9°25′S 147°26′E, 9°27′S 147°26′E, 9°28′S 147°27′E; P.N.G., N. distr., Safia, 135 m; P.N.G., Amazon Bay, Magarida Patrol Post; P.N.G., Amazon Bay area, Komania, 1020 m. **Solomon Is.**: Guadalcanal I., Ilu; Aola; Honiara distr.; Kukum; Lunga; Tetere; Tulagi, Lalang on ridge and Sasapi cutting; Wright's Creek; Tambalia, 35 km W. of Honiara, 30 m.

DISTRIBUTION (Fig. 120, and Biogeography section, p. 316). *G. musicus* occurs in Tasmania, Australia, New Guinea, and the Solomon Is.

BIOLOGY. *G. musicus* frequents tall grass with patches of bare ground, with or without trees (Common, 1948). There are normally two generations in central Queensland and one on the New South Wales tablelands. In suitable conditions eggs may hatch 17 days after laying, though they can remain viable for up to 10 months. The nymphal stages are completed in 39–48 days. Hatching occurs in September–November and January–March (Common, 1948; Key, 1938) and adults are found from October to May. Eggs are laid in firm bare soil, and egg fields may cover 0·4–4·0 ha at densities of up to 36 pods/m^{-2} (Common, 1948; Mungomery, 1944). Details of egg pods and eggs are given by Common (1948). Swarms occur periodically in Queensland and move southward and coastward. Individuals from swarms show phase changes in behaviour and morphology, having longer wings and less pronounced sexual dimorphism than solitary insects (Common, 1948). The species is preyed upon by numerous insects and birds (Carrick, 1959; Common, 1948; Mungomery, 1945; Fuller, 1938; Uvarov, 1928). There are many reports of occasional damage by swarms to pasture and a variety of crops (Common, 1948), especially sugarcane. In Queensland in 1962 *G. musicus* was calculated to have caused losses of 4851 t to this crop over a total area of 5346 ha (Wilson *et al.*, 1963). It has been suggested, however, that even spectacular defoliation may ultimately have little effect on yields (King *et al.*, 1953). All the available information on this species relates to Australian populations. There are no data from New Guinea or the Solomon Is.

DISCUSSION. The mainland form of *G. musicus* is characterised by the bright yellow basal area of the hind wing and the red ventral surface of the hind femur. The population in central New Guinea, across the straits from Cape York, is identical to the mainland form, but further east there is a noticeable loss of depth of the yellow colour of the hind wing and some reduction in the red colour of the hind femur. This population is intermediate between the mainland form and the extreme condition of the Solomon Is. race which exhibits almost complete loss of colour in both the wing and the hind femur. Comparing the morphometrics of the three forms there are relatively minor differences, but there is a slight trend of increasing size from central New Guinea eastwards to Guadalcanal as judged by both tegmen length and femur length. The formal taxonomic status of the eastern populations is best left undecided until larger samples are available for study, preferably with the back-up of comparative genetic studies.

Gastrimargus marmoratus (Thunberg, 1815)

(Figs 26–32, 119, 127)

Gryllus marmoratus Thunberg, 1815: 232. LECTOTYPE ♀, 'Cap.' [incorrectly labelled: actual locality unknown] (ZIUU, Uppsala), here designated [examined].

Gryllus transversus Thunberg, 1815: 232. LECTOTYPE ♀, CHINA (ZIUU, Uppsala), here designated [examined]. [Synonymised by Stål, 1873: 124.]

Gryllus virescens Thunberg, 1815: 245. Holotype ♂, no locality data (ZIUU, Uppsala) [examined]. [Synonymised by Stål, 1873: 124.]

Gryllus assimilis Thunberg, 1815: 246. Holotype ♂, no locality data (ZIUU, Uppsala) [examined]. [Synonymised by Stål, 1873: 124.]

Pachytylus (*Oedaleus*) *marmoratus* (Thunberg) Stål, 1873: 123.

Oedaleus (*Gastrimargus*) *marmoratus* (Thunberg) Saussure, 1884: 112.

Oedaleus (*Gastrimargus*) *marmoratus* stirps *sundaicus* Saussure, 1884: 113. LECTOTYPE ♀, SUMATRA (MHN, Geneva), here designated [examined]. [Synonymised by Sjöstedt, 1928: 34.]

Oedaleus (*Gastrimargus*) *marmoratus* var. *sundaicus* Saussure; Saussure, 1888: 39 [erroneously including material from the Congo].

Oedaleus (*Gastrimargus*) *marmoratus* var. *grandis* Saussure, 1888: 39. Holotype ♀, CHINA (NR, Stockholm) [examined]. [Synonymised with var. *sundaicus* by Kirby, 1910: 228.]

Gastrimargus virescens (Thunberg) Kirby, 1910: 226.

Gastrimargus assimilis (Thunberg) Kirby, 1910: 226.

Gastrimargus marmoratus (Thunberg) Kirby, 1910: 226.

Gastrimargus transversus (Thunberg) Kirby, 1910: 227.

Gastrimargus sundaicus (Saussure) Kirby, 1910: 228.

Gastrimargus marmoratus var. *transversa* (Thunberg); Sjöstedt, 1928: 37.

Gastrimargus marmoratus var. *grandis* (Saussure) Sjöstedt, 1928: 37.

Gastrimargus marmoratus var. *grandis* forma *rectinotum* Sjöstedt, 1928: 37. Type data unknown. [Unavailable infrasubspecific name.]

DIAGNOSIS. Fastigium of vertex slightly convex. Pronotum with median carina arcuate, sometimes intersected by posterior sulcus; hind margin sharply acutangular. Tegmen surpassing folded hind knees by one-quarter to two-fifths of hind femur length. Genitalia (Figs 26–32) variable, similar to *G. africanus*, but with aedeagus more strongly projecting.

Coloration variable. Pronotal ×-marking with posterior arms usually indistinct or absent. Transverse bands on tegmen sometimes reduced. Hind wing fascia (Fig. 127) complete, with some diffusion of dark pigment towards wing apex along third and subsequent anal veins, more marked in female; basal area of wing pale yellow with pale blue tinge on bases of veins; apex lightly infumate. Hind femora externally with variable oblique transverse banding, often absent except for rows of black dots on upper and lower carinulae; internal surface with dots on carinulae and indistinct brown patch in basal half of medial area only; ventral surface straw-coloured. Hind tibiae light red.

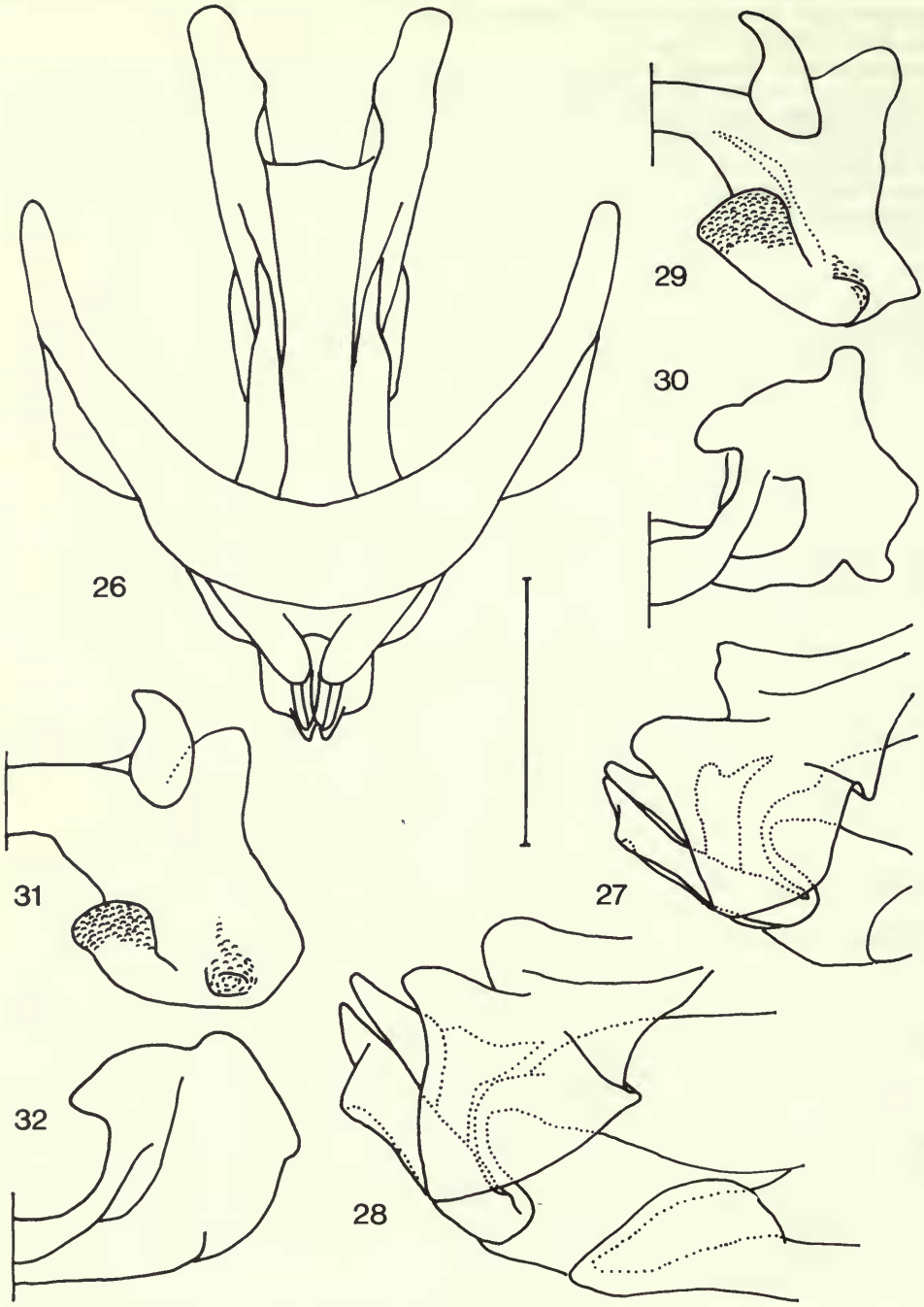
MEASUREMENTS

Sample from Thailand.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	39·46	5·19	8·19	29·68	20·27	4·14	4·89	3·63
Range	34·3–43·9	4·5–6·0	6·8–9·3	25·6–33·0	16·8–23·8	3·6–4·6	4·1–5·2	3·3–4·0
S.D.	2·619	0·396	0·759	1·960	2·010	0·305	0·247	0·174
n	22	22	19	22	21	21	21	19
Females								
Mean	57·42	7·65	11·63	43·02	28·62	6·02	4·76	3·72
Range	55·0–61·2	7·0–8·3	10·6–13·1	39·5–46·2	26·6–31·9	5·5–6·8	4·4–5·0	3·4–3·9
S.D.	2·057	0·388	0·805	1·919	1·701	0·363	0·222	0·185
n	10	12	10	11	12	12	12	9

Sample from Malaysia.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	35·89	4·71	7·51	26·91	17·79	3·67	4·75	3·60
Range	31·4–39·7	4·1–5·2	6·5–8·8	23·6–30·2	15·3–20·2	3·2–4·0	4·9–5·3	3·2–4·3
S.D.	2·053	0·252	0·523	1·627	1·220	0·207	0·540	0·196
n	33	33	30	33	30	30	30	30
Females								
Mean	53·48	7·08	11·07	40·49	26·67	5·63	4·74	3·66
Range	49·6–56·7	6·4–7·5	10·2–12·2	43·2–37·7	24·0–28·4	5·1–6·1	4·4–5·1	3·4–3·9
S.D.	2·320	0·263	0·638	1·800	1·268	0·309	0·202	0·119
n	14	16	16	15	15	15	15	15



Figs 26–32 *Gastrimargus marmoratus*, genitalia. 26, phallic complex, dorsal view (New Guinea); 27, same, posterior portion, lateral view (Borneo); 28, same (New Guinea); 29, epiphallus, right half, dorsal view (Borneo); 30, same, posterior view; 31, same, dorsal view (New Guinea); 32, same, posterior view.

AFFINITIES. *G. marmoratus* is related to *G. africanus* from which it differs principally by the longer wings and hind femora, the more pointed pronotal hind margin, the pale basal area of the hind wing, and the absence of blue pigment on the underside of the hind femur. In E. China and Burma where *G. africanus* loses the bright yellow hind wing colour and blue underside of the hind femur, there is need of care to distinguish the two species.

MATERIAL EXAMINED

Gryllus marmoratus Thunberg, lectotype ♀, locality unknown [incorrectly labelled "Cap"] (ZIUU, Uppsala). *Gryllus transversus* Thunberg, lectotype ♀, **China**: no locality data (ZIUU, Uppsala). *Gryllus virescens* Thunberg, holotype ♂, locality unknown (ZIUU, Uppsala). *Gryllus assimilis* Thunberg, holotype ♂, locality unknown, (ZIUU, Uppsala). *Oedaleus* (*Gastrimargus*) *marmoratus* stirps *sundaicus* Saussure, lectotype ♀, **Sumatra**: no locality data (MHN, Geneva). *Oedaleus* (*Gastrimargus*) *marmoratus* var. *grandis* Saussure, holotype ♀, **China**: Kiang-si (NR, Stockholm).

In addition to the type-material, 550 specimens were examined from the following localities: **India**: Assam, Upper Shillong, 1740 m; Assam, Udalguri. **Burma**: 64 km N. of Rangoon, Hmanbi. **China**: Fujian, Fuzhou, 680 m; Zhejiang, Zhuzhou; Jiangsu Prov., Shanghai, Zuoze; Sichuan Prov., Chongqing; Luzhou; Nanjing, Shouning; Nanjing; Guangzhou, Henan I., Panyu distr.; Guangzhou, Baiyun Shan; Hailing; Zhusan; Dailing Shan, 'nr Nong Po'; 'Dinding Is.'; Sichuan, Zhongjing, Beibei distr.; Sichuan, 'Baian-Kara-Ula Range', Emei Shan, 750 m; Guangdong, Guangzhou; Fujian Prov., 'mts nr Yenping'; Jiangsu, Suzhou; Jiangsu, Wushi; Manchuria, Shenyang; Shandong peninsula, Yantai; Fujian, 'Kuatun', 2300 m, 27°40′N 117°40′E; Fujian, Shaowu, 500 m; Fujian, Guangze. **Hong Kong**: Lantao I.; New Territories. **Korea (South)**: Seoul; Quelpart, S Ichikawa. **Korea (North)**: Pu-wong. **Japan**: Kyoto, Yamashiro I.; Yokohama; Loo Choo Is.; Takikawa. **Taiwan**: Taihorin; Taihauroka; Koroton; Tamsui valley, Tien Mu (Shin Lin). **Thailand**: Trong, Lower Siam; Kedah; Saraburi; Muakleg, Nakhon Ratchasima; Yala; Bangken–Bankok; Ban Bung, 15 km ESE. of Si Lacha; 24 km W. of Vitara Dit; Chomphorn; Roi Ed; Nan Nan Exp Stn; 13 km ENE. of Tak; Nongkhai; Surathani; Ban An Khae. **Vietnam**: Tuyen Quang; Dan Tieng, 60 km WNW. of Saigon. **Malaysia**: Penang; Pulo Penang; Pucong; Kuantan Pahang; 13th km, Pekan road; Serdang; Kuala Slen; Klang gates; Kuala Lumpur; Kedah Peak, 900–1000m; nr Tampin; Parit Buntar, Perak. Singapore. **Philippines**: Luzon, Manila; Karaan, Orion; Luzon, Laguna, Los Baños; Mountain Prov., Abatan, Buguias, 60 km S. of Bontoc, 1800–2000 m; Mt Montalban, Rizal, Wa-Wa dam, 150–200 m; Mt Prov, Mayoyao, Ifugao, 1000–1500 m; Ifugao Prov., Jacmal Bunhian, 24 km E. of Mayoyao, 800–1000 m; Mindanao, Cotabato Prov, Polo, nr base of Mt Matutum, 750 m; Lanao, L. Lanao Tagaya, 470–720 m; Albay Prov, Libon, Caguscos, 200 m; Mindoro; Santa Fé, Bukidnon, Mindanao, 600 m; Olongopa, Luzon, 16 km E., 360 m; Ulu Talia, Batang Ai, on padi; Temudok, on grass. **Borneo**: Sampit; Nanga-Badau; Sintang; S. Peleben; Sabah, Tambunan; Sabah, Liawan; Sabah, W. coast, Residency, Ranau, 500 m; Sabah, Sensuran; Balikpapan, Wain R., 50 m; Kembang Djangut, 75 m; Sabah, Sandakan distr., Rumidi Est., R. Labuk, 15–45 m; Mesilan, Mt Kinabalu; Sarawak, Semongoh, on wild grass; Sarawak, Nanga Pelagus, nr Kapit, 180–585 m, secondary forest; Sarawak, Gunong Natang, 120 m; Sarawak, Ban distr, Bidi, 90–240 m; Sarawak, Kapit distr., Merirai valley, 30–300 m, secondary forest; Sarawak, Kampong Pueh, Lundu distr., 690–1500 m. **Sumatra**: Sungei Penok, Korinchi valley, 780 m; Pasir Ganting, W. coast, 2°S; Batu Sangkar, Padang Bovenld, Goenong Soegi, Lampong; Dabu Singkap, Riouw; Tobameer; Balige, Sawahs; Solok, Rudang Prov; SW. Lampons, Mt Tanggamoes. **Java**: Djakarta; Bogor, botanic gardens; Sukabumi, 600 m; Pengalengan, 1200 m; Preanger; Buitenzorg; Palaboehan Ratoe; Volcan Gede; Tjimerang, Mt Djampang; Bandoeng, 700 m; Djember; Pantjar to Bogor, 500 m. **Sulawesi**: Bua-Kraeng, 1500 m; Lompobatang, 1100 m; Latimodjong Mts, Oeroe, 800 m; Minahassa, Tomohon; Tondano, Minahassa; Marinsow, Minahassa, 100 m; Mapanget, Minahassa, 5 m. **Lombok**: Segare Anak, 2000 m; E. Lombok, Swela, 300–450 m. **Flores**: W. Flores, Rana Mêsé; Komodo I.; Ruteng. **New Guinea**: Irian Jaya, Vogel Kop, Kebar valley, W. of Manokwari, 550 m.

DISTRIBUTION (Fig. 119, and Biogeography section, p. 316). *G. marmoratus* is widely distributed in SE. Asia from Assam north-east to Japan, south-west to Sumatra, and south-east to the Vogelkop peninsula of New Guinea. Records from India other than Assam (e.g. Katiyar, 1960) should be referred to *G. africanus*.

BIOLOGY. *G. marmoratus* frequents tall grassland, old cultivations, and grazing land, often with Lalang (*Imperata arundinacea* Cyr.) (Miller, 1932; 1934; Tinkham, 1935*b*; Roffey, 1979). It is also found around rice paddy, and on shrubs (Tsyplenkov, 1970). There is little information available on the life cycle in nature. In Taiwan there are two generations, with overwintering normally as eggs, rarely as nymphs. There are six nymphal instars occupying 54–102 days in total

(Sonan & Fukuda, 1926). There are records of damage to maize, rice, sorghum, citrus, sugar cane, cocoa, and oil palm (Roffey, 1979). Adults are preyed on by *Sphex* (*Prionony*x) *subfuscatus* (Dahl) (Piel, 1935), and eggs and nymphs are attacked by the fungus *Metarrhizium* sp. (Wood, 1968).

DISCUSSION. *G. marmoratus* 'stirps' *sundaicus* was based on female specimens of the brown morph of *G. marmoratus* from Sumatra. These exhibit light and dark brown mottling or streaking on the dorsum of the pronotum. This type of coloration occurs widely and is of no geographical or racial significance. The type-locality 'Cap.' (Cape of Good Hope) for *G. marmoratus* is a labelling error first noted by Stål (1873) which probably arose during Thunberg's extensive travels, first to the Cape and then to east Asia. From Thunberg's descriptions of *G. virescens* and *G. assimilis* there is some suggestion that the two type-specimens may subsequently have been switched. In Thunberg's description of *G. assimilis* (1815) he states that it is '*simillimus G. virescenti sed duplo fere minor*', i.e. half the size of *G. virescens*. In fact, as noted by Sjöstedt (1928: 35), the specimen now labelled as *G. virescens* is the smaller, but a confusion of labels cannot be proved and is not now of taxonomic importance.

In addition to the lectotype female of *G. marmoratus* in the ZIUU, Uppsala, there is one female paralectotype. There is also one male paralectotype of *G. transversus* in the same collection. Both paralectotypes are without locality data. The lectotype female of *G. marmoratus* stirps *sundaicus* in the MHN, Geneva, bears the following labels, apparently in Saussure's hand: 'Sumatra' '*marmoratus* Thbg. Var. *sundaicus* Sss. Îles des Indes'. The status of other specimens is unclear and paralectotypes have accordingly not been designated.

It is historically interesting that Thunberg's *Gastrimargus* specimens are mounted on contemporary eighteenth century needles rather than pins with the exception of the lectotype of *G. marmoratus* and the holotype of *G. assimilis* which have subsequently been repinned. Presumably pins were not available during long sea voyages whereas needles would have been essential equipment on board ship.

Gastrimargus immaculatus (Chopard, 1957)

(Figs 33–36, 116, 128)

Oedaleus immaculatus Chopard, 1957: 51. Holotype ♂, RÉUNION (MNHN, Paris) [examined].
Gastrimargus immaculatus (Chopard) Têtefort & Wintrebert, 1965: 650.

DIAGNOSIS. Fastigium convex. Pronotum with median carina low arcuate or flat, not intersected by posterior sulcus; posterior margin blunt acutangular or rectangular. Tegmen surpassing folded hind knees by one-third or hind femur length. Genitalia (Figs 33–36) similar to *G. africanus*; aedeagus very short, epiphallus with convergent outer lophi.

Coloration similar to *G. africanus*. Pronotal ×-marking sometimes obsolete in green morphs. Tegmen opaque brown, clearing in apical half, usually lacking pale transverse bands (Fig. 128). Hind wing basal area very pale yellow, fascia (Fig. 128) variable, sometimes indistinct or absent between costal margin and 3*A*, usually interrupted between *M* and 2*A* in males; in female fascia restricted to anal area posterior to 3*A* or absent. Hind femur externally as in *G. africanus*; internal surface dark brown in basal half of medial area only; ventral surface straw-coloured. Hind tibia orange red.

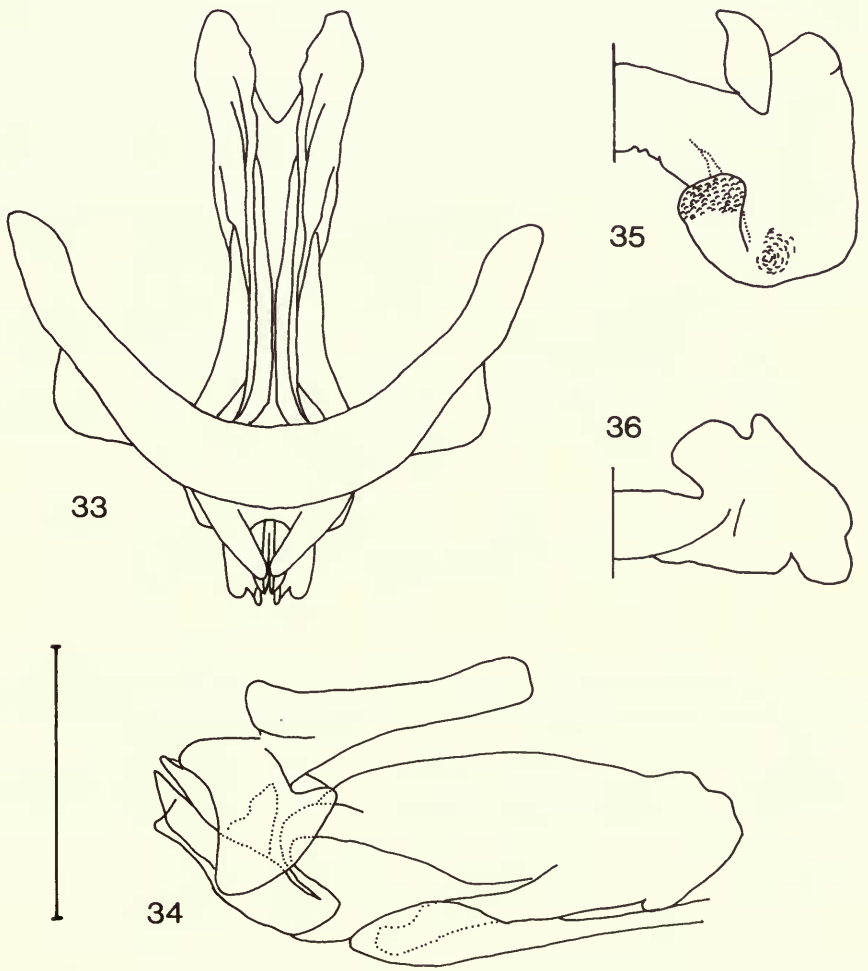
MEASUREMENTS
Sample from Réunion.

	Males							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	26·00	3·95	5·28	18·95	12·98	3·26	3·98	3·59
Range	23·1–29·2	3·7–4·3	4·5–6·0	16·5–21·8	11·7–14·3	2·9–3·6	3·6–4·3	3·3–3·9
S.D.	1·473	0·196	0·343	1·195	1·715	0·189	0·166	0·164
n	23	23	23	23	23	23	23	23

MEASUREMENTS—(*cont.*)

	Females							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	35·87	5·82	7·63	25·61	17·49	4·63	3·79	3·36
Range	33·8–37·7	5·3–6·3	6·5–8·1	24·2–27·1	15·9–18·9	5·0–4·1	3·5–4·1	3·1–3·8
S.D.	1·100	0·223	0·374	0·841	0·894	0·237	0·177	0·161
n	19	20	20	19	20	20	20	20

AFFINITIES. *G. immaculatus* is allied to *G. africanus* and its relatives on the basis of the male genitalia. It has, however, lost the bright yellow colour of the hind wing basal area and the blue underside of the hind femur. In this respect it resembles *G. marmoratus*, but there is further reduction in the hind wing fascia and the species is much smaller than any of its near relatives.



Figs 33–36 *Gastrimargus immaculatus*, genitalia. 33, phallic complex, dorsal view; 34, same, lateral view; 35, epiphallus, right half, dorsal view; 36, same, posterior view.

MATERIAL EXAMINED

Oedaleus immaculatus, holotype ♂, **Réunion**: Plaine des Cafres, 29.i.1955 (MNHN, Paris).

Réunion: 20 ♂, 11 ♀, Plaine des Cafres, 9.xii.1964 (*Wintrebert*) (MNHN, Paris); 1 ♂, same data (BMNH); 1 ♂, 3 ♀, same data, 11.xii.1964 (MNHN, Paris); 1 ♀, same data (BMNH); 2 ♀, Plaine des Cafres, Majastu, i.1912 (MNHN, Paris); 1 ♂, 2 ♀, Piton des neiges, Mare Kerveguen, 2000 m, 28–29.i.1955 (MNHN, Paris) (paratypes of *G. immaculatus*); 1 ♀, Plaine des Cafres, Piton Mare-à-boue, 29.i.1955 (MNHN, Paris) (allotype of *G. immaculatus*).

DISTRIBUTION (Fig. 116, and Biogeography section, p. 314). Réunion.

Gastrimargus hyla Sjöstedt, 1928

(Figs 37–40, 129, 130)

Gastrimargus hyla Sjöstedt, 1928: 28. Holotype ♀, ETHIOPIA (MNHN, Paris) [examined].
Gastrimargus abessinicus Sjöstedt, 1928: 28. Holotype ♀, ETHIOPIA (MNHN, Paris) [examined]. **Syn. n.**

DIAGNOSIS. Fastigium of vertex flat or slightly concave. Pronotum laterally rugose; median carina low arcuate, intersected by posterior sulcus; hind margin blunt acutangular. Lateral and ventral surfaces of thorax sparsely hairy. Tegmen surpassing folded hind knees by two-fifths of hind femur length in male, barely reaching hind knees in female. Tegmen length/pronotum length ratio 3·26 ♂, 2·38–2·67 ♀. Genitalia (Figs 37–40) similar to *G. rothschildi* (Figs 41–44), but aedeagus with smaller subapical ventral process.

Coloration brown or green. Pronotal × -marking thin, pale, with short, straight posterior arms (Figs 129, 130), not recurved; pronotal pattern may be obsolete in green morphs. Tegmen with cross bands obsolete. Hind wing fascia (Figs 129, 130) indistinct in male, narrowly interrupted by all major veins but otherwise complete, much fainter in female; basal area pale yellow. Hind femur externally with irregular dark brown dots along upper and lower carinulae and in medial area; internal medial and ventral areas unicolorous blue-black except for subapical pale ring above knee in male; blue-black replaced by maroon in female except for carinulae. Hind tibiae red.

MEASUREMENTS

All known material from Ethiopia, exact locality unknown.

Specimen	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
G. abessinicus, holotype ♀	29·8	5·7	7·9	20·2	16·4	4·3	3·8	2·5
G. abessinicus, paratype ♀	30·0	5·9	8·4	19·9	17·1	4·3	4·0	2·4
G. hyla, holotype ♀	30·7	5·8	8·1	21·5	17·2	4·4	3·9	2·7
Unique ♂	24·3	3·4	5·4	17·7	11·7	3·0	3·9	3·3

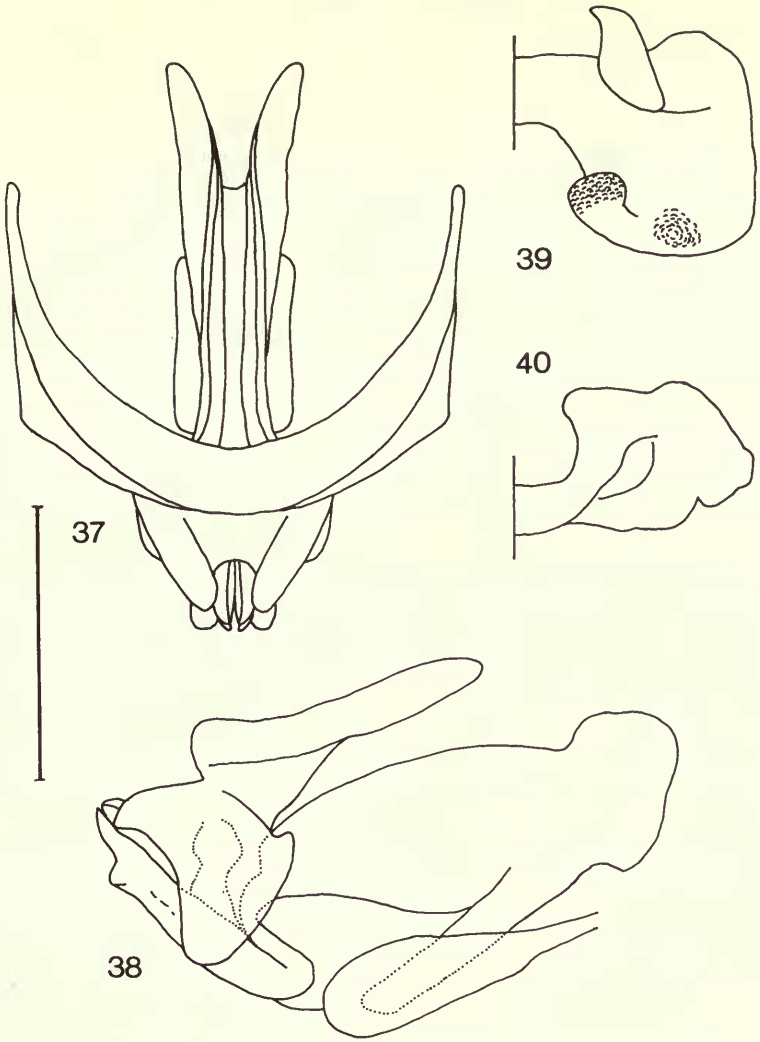
AFFINITIES. This species is allied to *G. rothschildi* on the basis of the genitalia and the reduction of the female tegmen length and hind wing fascia. The differences are outlined in the key (p. 244).

MATERIAL EXAMINED

Gastrimargus hyla Sjöstedt, holotype ♀, **Ethiopia**: no locality data, 1897–98 (*Michel*) (MNHN, Paris). *Gastrimargus abessinicus* Sjöstedt, holotype ♀, **Ethiopia**: no locality data, 1897–98 (*Michel & Potter*) (MNHN, Paris).

Ethiopia: 1 ♂, no locality data, 1899 (*Michel & Potter*) (MNHN, Paris); 1 ♀, same data (paratype of *G. abessinicus*) (NR, Stockholm).

DISTRIBUTION. All the known specimens of *G. hyla* were collected from an unknown locality or localities in Ethiopia by members of the ill-fated Bonchamps expedition to Fachoda (Michel, 1900). The general similarity of *G. hyla* to *G. abessinicus*, and in particular the short wings of the female, suggest that the species occupies a montane habitat like that of *G. abessinicus*. The expedition travelled west-south-west from Harer in the east to the White Nile at its junction with



Figs 37–40 *Gastrimargus hyla*, genitalia. 37, phallic complex, dorsal view; 38, same, lateral view; 39, epiphallus, right half, dorsal view; 40, same, posterior view.

the Sobat. Michel (1900: 90) recorded that the expedition's insect collections were already considerable by the time they had reached the junction of the Kesem and Awash rivers. One possible locality for the specimens of *G. hyla* is the eastern part of the Ahmar mountains near Harer, where the expedition spent some time. Another possible site is offered by the mountains along the road from Addis Ababa to Nekemte. It is known that a small collection of birds was made at 'Léka' in the 'Rogué mountains'. This evidently refers to the range just east of Nekemte. The expedition also passed through the mountainous area of the Menagesha National Forest, known to them as Mt Toké. More recent collecting in Ethiopia has so far failed to rediscover this species and its whereabouts remain a mystery.

Discussion. Sjöstedt (1928) repeatedly fell into the error of describing the green and brown morphs of the same species as separate taxa. In this instance *G. abessinicus* is merely the brown morph of *G. hyla*. The male of this species, unaccountably overlooked by Sjöstedt (1928), is here described for the first time, by courtesy of Dr M. Donskoff (MNHN, Paris).

Gastrimargus rothschildi Bolívar, 1922

(Figs 41–44, 114, 131, 132)

Gastrimargus rothschildi Bolívar, 1922: 175.

This species is here divided into two subspecies under which the synonymy is separately listed.

Diagnosis. Antennal flagellum short, thick, with bead-like segmentation; segments 8–9 barely longer than wide. Fastigium of vertex convex. Pronotum with median carina low arcuate, not intersected by posterior sulcus; posterior margin narrowly acutangular. Tegmen surpassing hind knee by one-twelfth to one-quarter of hind femur length in male, not reaching hind knees in female. Tegmen length/pronotum length ratio 2·46–3·18 ♂, 1·48–1·83 ♀. Genitalia (Figs 41–44) similar to *G. verticalis*, but smaller and more delicate; aedeagus more weakly protruding.

Coloration vivid green with variable dark maroon markings. Pronotal ×-marking thin, similar to *G. verticalis*, posterior arms elongated and incurved posteriorly (Figs 131, 132). Tegmen in male predominantly dark maroon in basal two-thirds, lighter brown in apical third and clearer, with two or three variable pale blotches or bands; female tegmen with maroon areas reduced to five or six blotches or bands on a green background. Hind wing unfasciated or with faint traces only; basal area pale yellow. Hind femur externally with longitudinal dark purple or maroon stripe extending to variable thickness below dorsal carinula, sometimes obsolete (for internal surface see key to subspecies below). Hind tibia basally dark brown, otherwise red.

Affinities. *G. rothschildi* is allied to *G. verticalis*, Ethiopian material of which exhibits a trend towards complete loss of the hind wing fascia (culminating in '*G. aethiopicus*' Bolívar, p. 275). Longer winged females of *rothschildi* may be difficult to distinguish from those of *G. verticalis* to which they bear a close resemblance, except for their darker tegminal pattern and higher TL/PL ratio. The males are more easily distinguished from those of *G. verticalis* by their smaller size and the absence of any distinct hind wing fascia. It seems probable that this species is a high-altitude derivative of *G. verticalis* (see p. 310). It would be interesting to investigate the ecology and genetics of the two races of *G. rothschildi* and the local population of *G. verticalis*. The relationship of *G. rothschildi* to *G. hyla*, another Ethiopian species, is discussed above (p. 268).

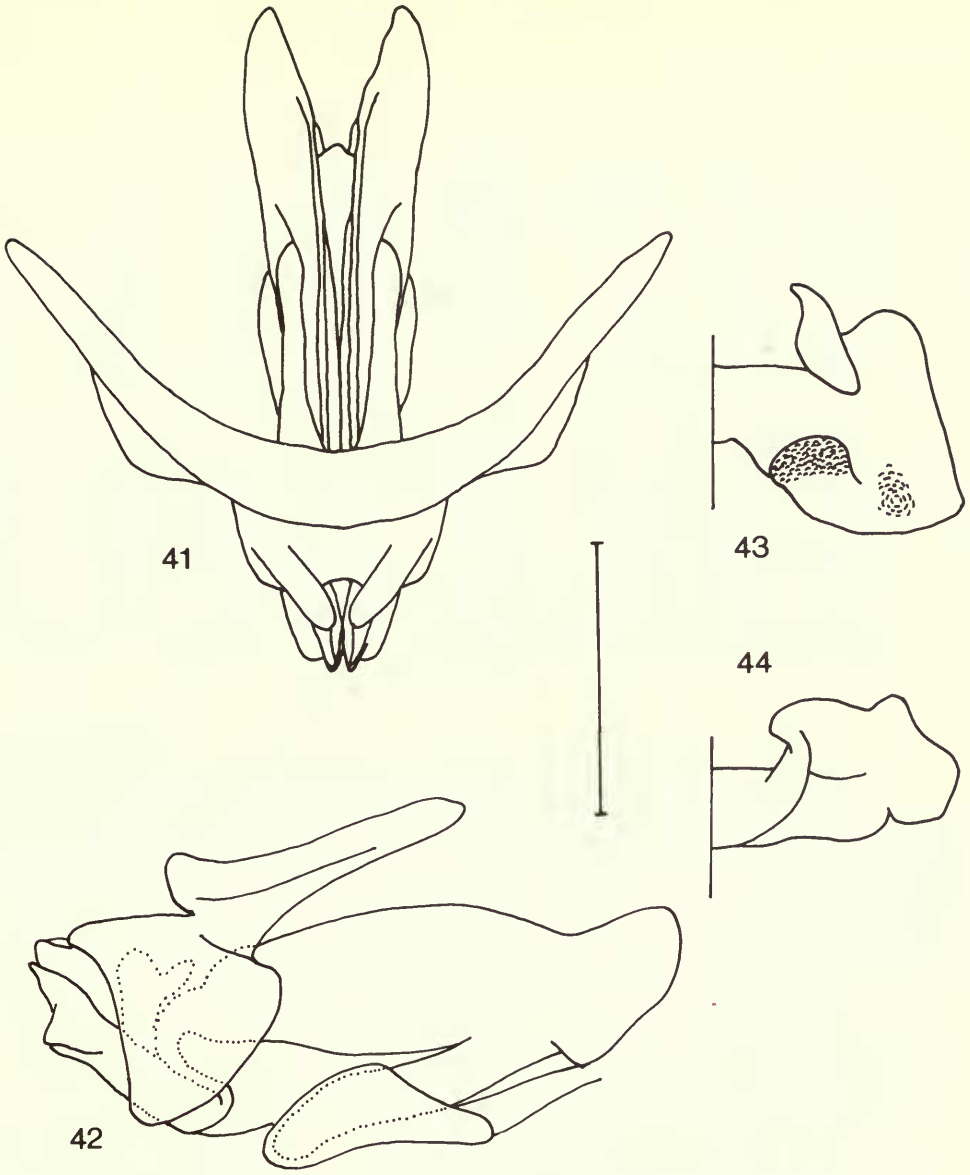
Distribution (Fig. 114, and Biogeography section, p. 310). *G. rothschildi* is restricted to montane Ethiopia. The nominate 'blue-leg' race occupies the two mountain areas on the east side of the great rift valley south of Asela, separated by the Wabi Shebele river, and also occurs in the Simien National Park area north-east of L. Tana to the west of the rift, where it is separated from the southern population by more than 250 km. In the intervening area the 'yellow-leg' race extends on the west side of the rift valley roughly from Sodo in the south to the Abay (Blue Nile) gorge north of the Goha Tsion in the north. It is not known whether either race is to be found north of the Blue Nile in the Mangestu mountains. The Abay may well bound the distribution of the species in the north as the Omo river valley does in the west. Both races generally occur above the 2000 m contour (shown as a thin continuous line on the distribution map, Fig. 114).

Discussion. *G. rothschildi rothschildi* exhibits considerable variation in size, wing length, and coloration within any given population and the newly synonymised taxa reflect this diversity. The newly described subspecies *G. rothschildi luteifemur* is recognised as a geographical race on the basis of the coloration of the hind femur described in the key below. This character is consistent within populations, is easily visible, and shows marked geographical discontinuity (Fig. 114, p. 311). I am indebted to Dr N. D. Jago for drawing my attention to the occurrence of geographical variation in hind femur colour in this species. The morphometrics of the two subspecies are substantially identical.

Key to subspecies of *Gastrimargus rothschildi*

1 Internal ventral carina and internal medial area of hind femur dull straw-coloured, at least partially tinged with blue-grey, blue-black, or mauve, never bright red
G. rothschildi rothschildi Bolívar (p. 271)

– Internal ventral carina and lower half of internal medial area of hind femur bright yellow straw-coloured, often tinged with bright red, never mauve or blue
G. rothschildi luteifemur subsp. n. (p. 273)



Figs 41–44 *Gastrimargus rothschildi*, genitalia. 41, phallic complex, dorsal view; 42, same, lateral view; 43, epiphallus, right half, dorsal view; 44, same, posterior view.

Gastrimargus rothschildi rothschildi Bolívar, 1922

Gastrimargus rothschildi Bolívar, 1922: 175. Holotype ♀, ETHIOPIA (MNHN, Paris) [examined].
Gastrimargus cristagalli Sjöstedt, 1928: 46. Holotype ♀, ETHIOPIA (BMNH) [examined]. **Syn. n.**
Gastrimargus rothschildi montanus Uvarov, 1934: 607. Holotype ♂, ETHIOPIA (BMNH) [examined]. **Syn. n.**

MEASUREMENTS
Sample from Ethiopia, Bale Province.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	22·49	3·48	6·03	16·26	12·54	2·93	4·28	2·71
Range	20·3–24·8	3·1–3·8	5·2–6·7	14·1–17·9	11·3–13·9	2·5–3·2	4·0–4·8	2·5–3·2
S.D.	1·250	0·147	0·414	0·977	0·728	0·157	0·195	0·188
n	20	20	20	20	20	20	20	20
Females								
Mean	26·59	5·90	10·18	16·58	17·61	4·79	3·68	1·64
Range	24·6–29·1	5·3–6·4	8·8–11·8	15·1–18·4	16·2–19·9	4·2–5·4	3·4–4·0	1·5–1·8
S.D.	1·380	0·288	0·765	1·003	0·956	0·329	0·159	0·113
n	17	17	17	17	17	17	17	17

MATERIAL EXAMINED

Gastrimargus rothschildi Bolívar, holotype ♀, **Ethiopia**: Kounhi, iv.1905 (*Rothschild*) (MNHN, Paris). *Gastrimargus cristagalli* Sjöstedt, holotype ♀, **Ethiopia**: no data (*Bowring*) ('one of Walker's series of *Pachytylus determinatus*') (BMNH). *Gastrimargus rothschildi montanus* Uvarov, holotype ♂, **Ethiopia**: Mt Chillálo, *c.* 3000 m, 22.xi.1926 (*Scott*) (BMNH).

Ethiopia: 1 ♂, Chillálo, *c.* 2700 m, 25.viii.1945 (*Guichard*); 7 ♂, 2 ♀, Mt Chillálo, short turf dotted with bush heath, *c.* 3000 m, 22.xi.1926 (*Scott*) (paratypes of *G. rothschildi montanus*); 4 ♂, Mt Chillálo, *c.* 2850 m, open short turf, 15.xi.1926 (*Scott*) (paratypes of *G. rothschildi montanus*); 1 ♂, Mt Chillálo, Digaila, *c.* 2850 m (*Scott*) (paratypes of *G. rothschildi montanus*; 1 ♂, Gondar, 1932 (*Griaule*) (MNHN, Paris); 1 ♂, Simien, camp nr Mecano-Abo, *c.* 3150 m, 12.xi.1952 (*Scott*); 1 ♂, Atgheba Ghiyorghis, *c.* 3270 m, 4.xii.1952 (*Scott*); 2 ♂, 2 ♀, Simien, Ambaras, Khabau (nr Ghitche), *c.* 3240 m, 18.xi.1952 (*Scott*); 40 ♂, 16 ♀, 20 nymphs, Bale prov., Dinchu Park Lodge area, 142 km E. of Shashamene, 3170 m, Juniper-*Hagenia* with swampy streams and giant Lobelia, 30.x.1975 (*Jago & Stretch-Liljer*) (COPR, London); 1 ♂, 1 ♀, same data (MNHU, Berlin); 1 ♂, Arusi/Bale prov., Shashamene-Goba road, 29 km E. of Shashamene, E. of Kofele, 2610 m, rolling grassland with circular hummocks, 29.x.1975 (*Jago & Stretch-Liljer*) (COPR, London); 5 ♂, 4 ♀, Bale prov., Shashamene-Goba road, 64 km E. of Shashamene, E. of Kofele, 2460 m, grass regrowth between fields of new and fallow barley and oats, 27.x.1975 (*Jago & Stretch-Liljer*) (COPR, London); 1 ♂, Bale prov., 162 km E. of Shashamene, just W. of Goba, 2450 m, weeds between fields of barley, 30.x.1975 (*Jago & Stretch-Liljer*) (COPR, London); 2 ♂, 1 ♀, Bale prov., E. of Adaba, 37 km W. of Dinchu, 2860 m, S. facing hill slope with grassland and barley, 2.xi.1975 (*Jago & Stretch-Liljer*) (COPR, London); 2 ♂, Bale prov., Bale Nat. Pk, military road above Goba, 11 km below upper plateau, 3100 m, Juniper woodland with grazed lawn, 31.x.1975 (*Jago & Stretch-Liljer*) (COPR, London); 1 ♂, Bale prov., W. of Adaba, between Adaba and Dodola, 2550 m, riverine acacia woodland, 2.xi.1975 (*Jago & Stretch-Liljer*) (COPR, London); 2 ♂, 2 ♀, Arusi prov., 8 km S. of Asela, Asela–Bekoji road, deeply incised valleys with *Podocarpus*, 19.xi.1975 (*Jago & Casey*) (COPR, London); 1 ♂, 1 ♀, Arusi prov., SSE. of Asela, track to Ticho S. of Mt Chillalo, 42 km W. of Ticho, deep volcanic gorge with barley, 20.xi.1975 (*Jago & Casey*) (COPR, London); 2 ♂, Arusi prov., 10 km W. of Ticho, Mt Bada, *Hagenia* forest zone, 21.xi.1975 (*Jago & Casey*) (COPR, London); 4 ♂, 1 ♀, 1 nymph, Arusi prov., 3 km W. of Ticho, juniper zone with lightly grazed pasture, 21.xi.1975 (*Jago & Casey*) (COPR, London); 1 ♂, 1 ♀, Bale reserve, Dinsho, 1600 m, 4–5.xi.1973 (*Rougeot*) (COPR, London).

Gastrimargus rothschildi luteifemur subsp. n.

MEASUREMENTS (all available material).

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	22·97	3·63	6·33	16·21	13·36	3·13	4·27	2·66
Range	20·7–25·7	3·0–4·3	5·6–7·3	14·4–18·2	11·8–14·6	2·7–3·5	4·0–4·6	2·2–3·2
S.D.	1·205	0·289	0·511	0·929	0·769	0·190	0·136	0·478
n	22	23	23	23	22	22	22	23
Females								
Mean	26·93	6·04	10·17	16·26	18·55	4·70	3·94	1·60
Range	24·3–29·0	5·5–6·6	8·9–11·1	14·6–17·3	16·2–19·3	4·3–5·1	3·8–4·2	1·5–1·8
S.D.	1·690	0·399	0·898	1·012	1·369	0·286	0·206	0·096
n	5	5	5	5	5	5	5	5

MATERIAL EXAMINED

Holotype ♂, **Ethiopia**: Shewa Prov., Addis Ababa–Nkemte road, 22 km W. of Addis Ababa, 2525 m, grazed pasture and *Eucalyptus* forest, 8.x.1975 (*Jago & Stretch-Liljer*) (BMNH).

Paratypes. **Ethiopia**: 1 ♀, same data as holotype (BMNH); 8 ♂, Mt Zuquála, *c.* 2700 m, 25–25.x.1926 (*Omer Cooper*) (paratypes of *G. rothschildi montanus*) (BMNH); 1 ♂, Addis Ababa,–Debra Marcos road, Abbai Gorge, *c.* 2100 m, 23.x.1945 (*Guichard*) (BMNH); 2 ♂, Addis Ababa, 2160 m, 8.xi.1945 (*Guichard*) (BMNH); 4 ♂, 1 ♀, Addis Ababa, 2100–2400 m, viii. 1945 (*Guichard*) (BMNH); 2 ♂, 1 nymph, Dessie area, 2400–2640 m, 1–25.iii.1953 (*Bryant*) (BMNH); 1 ♂, Wolamo Prov., Mt Damota, over 3000 m, from grassy slopes on summit and near spring, 5.xi.1948 (*Scott*) (BMNH); 1 ♂, Addis Ababa (MNHN, Paris); 1 ♂, 75 km N. on Fiche Road, 15.vii.1975 (*Stretch-Liljer*) (BMNH); 1 ♀, 10 km N. on Fiche road, 15.vii.1975 (*Stretch–Liljer*) (BMNH); 1 ♀, Wachamacha Mt, 3000–3300 m 23.vii.1947 (*Guichard*) (BMNH).

Gastrimargus verticalis (Saussure, 1884)

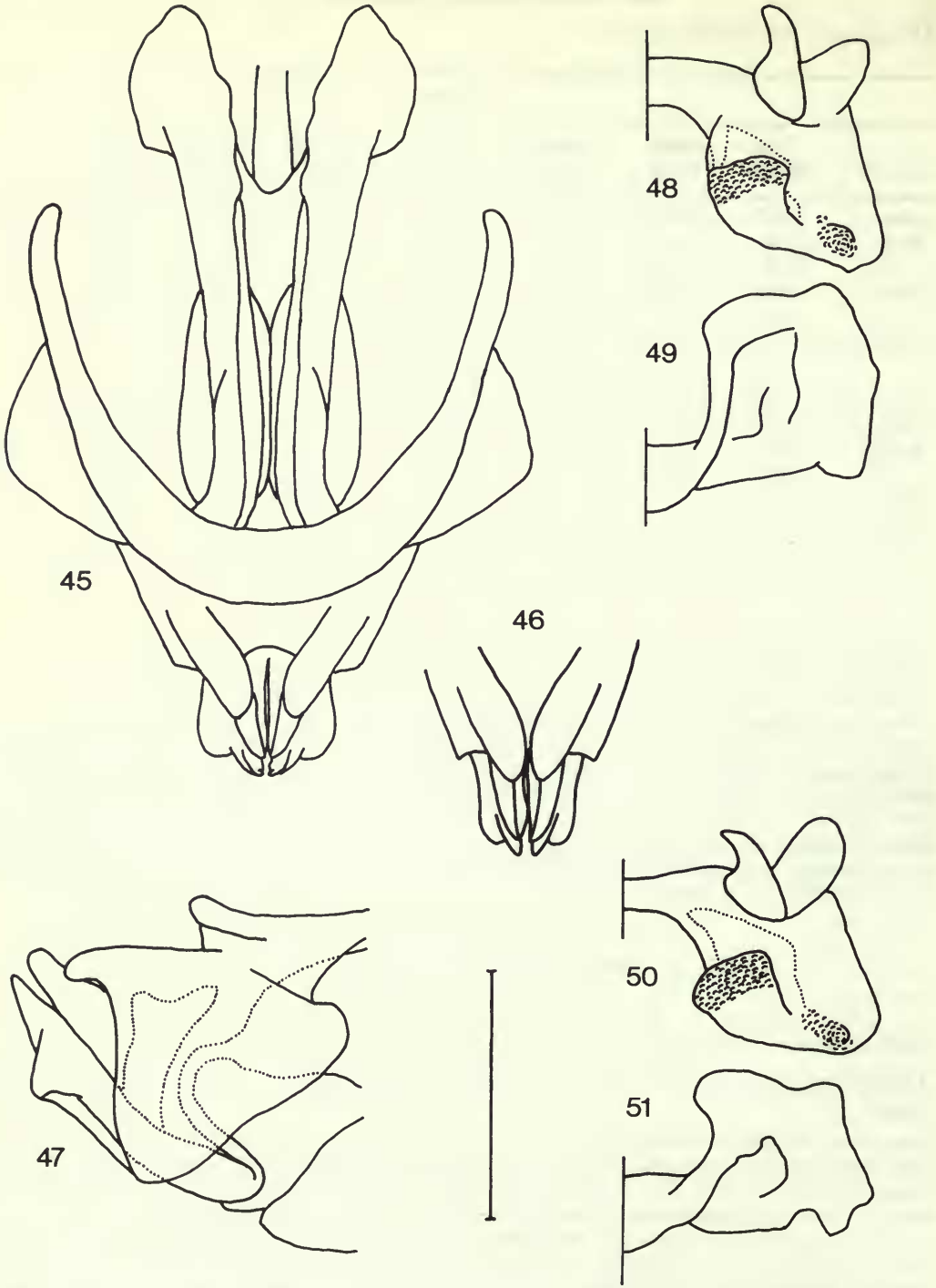
(Figs 45–51, 113, 133, 134)

Oedaleus (*Gastrimargus*) *verticalis* Saussure, 1884: 111.

This species is here divided into two subspecies under which the specific synonymy is separately listed.

DIAGNOSIS. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; hind margin acutangular. Tegmen surpassing folded hind knees by about one-eighth of hind femur length. Genitalia (Figs 45–51) with aedeagus moderately strongly protruding; epiphallus with lateral plate widening posteriorly, outer lobes of lophi small, rounded, straight or slightly divergent.

Coloration. Pronotal ×-marking with fine lines on dark background. Tegmen with two pale cross bands, basal band sometimes reduced or absent. Hind wing basally pale yellow; fascia (Fig. 133) complete in male, reaching and following hind margin of wing, interrupted between *Cu*2 and 1*A*, and sometimes, especially in Ethiopia, obsolete from costal margin to *Cu*2; fascia reduced in female, occasionally almost obsolete, especially in Ethiopia, ceasing to reach hind margin, thin, sometimes not reaching beyond *Cu*2 anteriorly. Hind femur externally with faint traces of transverse banding in medial area; upper carinula with row of black dots. Internal surface with medial area brown in basal half, upper and lower carinulae with row of dots; ventral surface straw-coloured. Hind tibiae pink or red in male, light brown in female.



Figs 45–51 *Gastrimargus verticalis*, genitalia. 45, *G. v. verticalis*, phallic complex, dorsal view; 46, *G. v. mpwapwae*, same, posterior portion only; 47, *G. v. verticalis*, same, lateral view; 48, *G. v. verticalis*, epiphallus, right half, dorsal view; 49, same, posterior view; 50, *G. v. mpwapwae*, same, dorsal view; 51, same, ventral view.

AFFINITIES. As already noted above (p. 270), *G. verticalis* is allied to the montane *G. rothschildi*. However, it also has affinities with *G. determinatus* and *G. miombo* with both of which it has sometimes been confused. All three species have the hind femur ventrally straw-coloured (except in *G. v. mpwapwae*), a strongly protruding aedeagus with large ventral lobe, and a pronotal ×-marking with the anterior and posterior arms of similar thickness.

DISTRIBUTION (Fig. 113, and Biogeography section, p. 308 et seq.). Eastern and south-eastern Africa. Two specimens from Nigeria which may belong to this species are discussed below and included on the distribution map (Fig. 113). The nominate subspecies is newly recorded from Madagascar on the strength of a single male in the MNHU, Berlin. This record needs confirmation.

BIOLOGY. Unknown. There is one record of damage to pasture in Kenya (Le Pelley, 1952).

DISCUSSION. The material of *G. verticalis* in the MHN, Geneva, includes two females from Natal, one of which was figured by Sjöstedt (1928) as the type. For reasons of stability the figured female is here designated lectotype and is labelled as such. It bears Saussure's original labels: 'Natal' and '*verticalis* Sss. Natal'. The other female with identical data is designated a paralectotype but the remaining material is of uncertain status and accordingly no further designations are made.

The holotype male of *G. brevipes* var. *abessina* was figured (Sjöstedt, 1928: pl. 3, fig. 4) and listed as having been deposited in MNHU, Berlin (Sjöstedt, 1928: 48). However, the specimen is not there (K. K. Günther, pers. comm.) and the male paratype in the NR, Stockholm bears a label in Sjöstedt's hand stating that the holotype is in Hamburg and not Berlin. Unfortunately the male specimen in the ZM, Hamburg is labelled as a paratype and not as the holotype (H. Strümpel, pers. comm.), while the single female paratype listed by Sjöstedt (in MCSN, Genoa) is wrongly labelled as the holotype (F. Capra and R. Poggi, pers. comm.). Evidently the type labels were attached to the wrong specimens by Sjöstedt. Labels with the correct information have now been added.

The four newly synonymised species are all based on female holotypes which demonstrate the wide range of variation shown by this species. The profile of the pronotal median carina and the degree of expression of the hind wing fascia are especially variable characters in the female, and unsuitable for characterising new species. The unique holotype of *G. aethiopicus* from Ethiopia represents the extreme condition of the hind wing, with almost complete loss of the fascia.

Males of *G. verticalis mpwapwae* are easily distinguished from the nominate subspecies by the characters given in the key below. In addition the aedeagus of *mpwapwae* appears somewhat more slender in dorsal view (Fig. 46). The female is indistinguishable from the nominate race.

Two specimens from Nigeria, a male from Bambur, and a female from Jakiri, both collected by F. D. Golding in May 1946, appear to be close to this species. The localities are shown on the distribution map (Fig. 113). The two insects are both very pale brownish green with very indistinct markings (♂, Fig. 135). The male aedeagus bears a larger and more rounded subapical ventral process than is normal in *G. verticalis*. A firm assignment of this material must await the discovery of further specimens. However, in the meantime it is certain that these insects do not belong to any of the species presently known from West Africa.

Key to subspecies of *Gastrimargus verticalis* (males only)

1 Tegmen with distinct pale cross-banding; apical half of hind wing clear, sometimes with faint brown speckling near wing tip (Fig. 133); hind femur ventral surface straw-coloured
G. verticalis verticalis (Saussure) (p. 275)

– Tegmen dark, with pale cross-banding reduced or absent; apical half of hind wing beyond fascia distinct infumate (Fig. 134); hind femur ventral surface tinged with blue-grey
G. verticalis mpwapwae subsp. n. (p. 277)

Gastrimargus verticalis verticalis (Saussure, 1884)

Oedaleus (*Gastrimargus*) *verticalis* Saussure, 1884: 111. LECTOTYPE ♀, SOUTH AFRICA (MHN, Geneva), here designated [examined]. [Incorrectly synonymised with *G. determinatus* by Kirby, 1902: 71.]
Gastrimargus verticalis var.; Burr, 1900: 39.

Gastrimargus aethiopicus Bolívar, 1922: 175. Holotype ♀, ETHIOPIA (MNHN, Paris) [examined]. **Syn. n.**
Gastrimargus longipes Sjöstedt, 1928: 21. Holotype ♀, SOUTH AFRICA (NR, Stockholm) [examined]. **Syn. n.**
Gastrimargus longipes var. *recta* Sjöstedt, 1928: 22. Holotype ♀ [not cotype as labelled], ZANZIBAR (NR, Stockholm) [examined]. **Syn. n.**
Gastrimargus longipes var. *decliva* Sjöstedt, 1928: 22, Holotype ♀, TANZANIA (BMNH) [examined]. **Syn. n.**
Gastrimargus brevipes Sjöstedt, 1928: 22. Holotype ♀, TANZANIA (NR, Stockholm) [examined]. [Synonymised with *G. verticalis* by Dirsh, 1966: 428.]
Gastrimargus brevipes var. *elgonensis* Sjöstedt, 1928: 23. Holotype ♀, KENYA/UGANDA (NR, Stockholm) [examined]. [Synonymised with *G. verticalis* by Dirsh, 1966: 428.]
Gastrimargus brevipes var. *abessina* Sjöstedt, 1928: 23. Holotype ♂, ETHIOPIA ZM, Hamburg) [not MNHU, Berlin as stated by Sjöstedt, 1928: 48]. [Synonymised with *G. verticalis* by Dirsh, 1966: 428.]
Gastrimargus verticalis var. *fusca* Johnston, 1956: 570. Holotype ♀, SOMALI REPUBLIC: Hargeisa, 25–28.iv.1895 (*Peel*) (lost). [Name given to Burr's (1900: 39) unnamed var. by Johnston and erroneously attributed by him to Burr, synonymised with *G. verticalis* by Dirsh, 1966: 428.]

MEASUREMENTS
Sample from Uganda.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	31·46	4·62	7·51	23·02	17·94	3·67	4·99	3·07
Range	29·1–33·6	4·2–4·9	6·6–8·2	21·1–24·6	16·0–19·8	3·3–4·1	4·5–5·3	2·8–3·3
S.D.	1·201	0·162	0·428	0·921	0·826	0·164	0·625	0·142
n	30	30	29	30	30	30	30	29
Females								
Mean	48·20	7·93	12·03	34·52	27·00	5·75	4·70	2·87
Range	45·5–52·3	7·3–8·7	11·0–13·4	32·0–40·0	24·5–29·9	5·4–6·3	4·4–5·0	2·6–3·6
S.D.	1·803	0·309	0·668	1·716	1·249	0·209	0·183	0·185
n	29	29	28	29	29	29	29	28

MATERIAL EXAMINED

Oedaleus (*Gastrimargus*) *verticalis* Saussure, lectotype ♀, **South Africa**: Natal, no further data (MHN, Geneva). *Gastrimargus longipes* Sjöstedt, holotype ♀, **South Africa**: Natal, Appelbosch, iv. (*Ljungqvist*) (NR, Stockholm). *Gastrimargus longipes* var. *recta* Sjöstedt, holotype ♀, **Tanzania**: Zanzibar (*Hildebrandt*) (NR, Stockholm), *Gastrimargus longipes* var. *decliva*, holotype ♀, **Tanzania**: Kitope, Dodoma, 6.iv.1927 (*Miller*) (BMNH). *Gastrimargus aethiopicus* Bolívar, holotype ♀, **Ethiopia**: Kaussa, 1905 (*de Rothschild*) (MNHN, Paris). *Gastrimargus brevipes* Sjöstedt, holotype ♀, **Tanzania**, Kilimanjaro, 1.i.1905–06 (*Sjöstedt*) (NR, Stockholm). *Gastrimargus brevipes* var. *elgonensis* Sjöstedt, holotype ♀, **Kenya/Uganda**: Mt Elgon, 1700 m, vii (*Lovén*) (NR, Stockholm).

In addition to the type-material listed above, 639 specimens were examined from the following localities. **Sudan**: Arua. **Ethiopia**: Gamo Prov., Nr Ezo, *c.* 2880 m; Wolamo Prov., points between Sodu and Boroda, 1500–2100 m; W. of Mt Zuquala, Awash R., *c.* 1800 m; Eritraea, nr Senafe; L. Zwai; Meisso; Mega; Bishoftu, 48 km SE. of Addis Ababa; Wallo, Yezu escarpment; Asba Taffari, 1740 m; 1 ♂, Wonda, nr Maltke, 7.xii.1900 (*Erlanger*) (paratype of *G. brevipes abessina*) (NR, Stockholm); Addis Ababa to Dessie road, S. of Karacori, 1500 m; Marocco; L. Bishoftu, 2100 m; Shewa Prov., SE. of Addis Ababa, km 32 on Debre Zeit road. **Somali Republic**: Hargeisa distr., Tug Wajali; Coralei, 9°36′N 42°50′E; Moccanis, 9°33′N 42°57′E; 9°20′N 43°40′E; 9°25′N 43°50′E; Baba Gob, 9°07′N 44°30′E; Qodah, 9°08′N 45°00′E; Faroweina, 9°40′N 43°00′E. **Kenya**: Kisumu, Kisat; Masai Cis Mara, Kipleleo plain; Ngobit, Aberdare Mts, 2100 m; Ngong; Kibibi basin; Kilimanjaro, 1200–1800 m; Ngatana; Karura forest, Nairobi; Nyeri (S); Kitale; Novosura; Thika, 1350 m; Timbaroa; nr Kericho; nr Naivasha; L. Nakuru; Subukia, nr Nakuru; Nairobi;

Baringo, 1200 m; Chyulu hills, 02°38·5′S 37°51·5′E, 1650–1680 m; Giaki farm, 00°01·5′N 37°46′E; Tebere, C.R.S, 00°39·5′S 37°23′E; Kitui, 01°22′S 37°59′E; Ngariama, 00°34·5′S 37°23·5′E; Marsabit; Rabai; Mt Kulal, N.F.D, 02°35′N 36°55′E, 1650–1950 m; Samburu distr.; Kisumu; Emali Range, Sultan Hamud, 1470–1770 m; Ngong escarpment; Naitalia; Wasin Gisha, 1st beacon camp; Plains W. of Mt Kenya; Marsabit, L. Paradise; Kitito coffee estate, Makuyu, 00°58′S 37°17′E, 1550 m; Mt Margaret to Narok road, 01°06′S 36°06′E, nr Ntulelei village, 2040 m. **Kenya/Uganda**: 1 ♂, 2 ♀, Elgon, 2000 m, vii.(*Lovén*) (paratypes of *G. brevipes* var. *elgonensis*) (1 ♀, MNHN, Paris, 1 ♂, NR, Stockholm); 1 ♀, Elgon, 1700 m, vi.(*Lovén*) (paratype of *G. brevipes* var. *elgonensis*) (MHN, Geneva); 1 ♂, same data, 2000 m (paratype of *G. brevipes* var. *elgonensis*) (MHN, Geneva). **Uganda**: 1 ♂, Entebbe, xi. 1912 (*Gowdey*) (paratype of *G. brevipes*); Mawakota; Kampala; Mbale; Bweya; Kivuvu; Tororo to Jinja; Tororo to Mbale road; Tororo, Tororo hill; Banda, Chagwe; Bulewezi, Luwero; Ankole, Lutobo; Ankole, Bukinda, *c.* 1650 m; Ankole, L. Karenge; Ankole, Kashenji, 2100–2400 m; Kigezi, Mavungo, 1800–2100 m; Kigezi, L. Bunyoni to Kashenji, 1800–2100 m; Kigezi distr., 1650–1800 m, Mabungo; Kigezi, Bufundi, 1800–2100 m, Mwera. **Ruanda**: Njarugenje. **Zaire**: Ituri distr., N'dele; Nya Ngezi, 1530 m; Kivu, Kadjudju; Bunia, 1350 m. **Tanzania**: 1 ♂, Kilimanjaro, Kibonoto, 1300–1900 m, 14.xi.1905–06 (*Sjöstedt*) (paratype of *G. brevipes*) (NR, Stockholm); 1 ♂, Kilimanjaro, 18.xi.1905–06(*Sjöstedt*) (paratype of *G. brevipes*) (MHN, Geneva); SE. slope of Kilimanjaro, ab Marangu; Mutindi; Arusha Nat Pk; 1 ♀, Bukoba, xii.1921 (Miller) (paratype of *G. brevipes*); Singida; Old Shinyanga; Meru, 2100–2400 m; W. Kilimanjaro, Ngare to Nairobi, 1200–1500 m; Ngorongo, Rest house, 2400 m; Oldeani distr.; Tukuyu, 1525 m; Manow. **Zimbabwe**: Mt Selinda, 1350 m. **South Africa**: Cape Province, Bizana distr., Pondoland East; C. P., East London; C. P., Keurboom R.; 1 ♀, C. P., Knysna ('one of Walker's series of *P. determinatus*'); C. P., Swellendam; C. P., Knysna, Harkerville, 240 m; C. P., Grahamstown; Natal, Zululand, Nagana Res. Lab.; Natal, Nqutu; Natal, Howick; Natal, Maritzburg; Natal, Zululand, lower Umfolosi R.; 1 ♀, Natal, Durban ('Port Natal') ('one of Walker's series of *P. determinatus*'); 1 ♂, Natal, Appelbosch, iv.(*Ljungqvist*) (paratype of *G. longipes*) (NR, Stockholm); 1 ♀, Natal, no further data (paralectotype of *G. verticalis*) (MHN, Geneva); Orange Free State, Gum Tree; O. F. S., Orange R. Colony; Transvaal, Eureka, nr Barberton. **Madagascar**: Tananarive.

Gastrimargus verticalis mpwapwae subsp. n.

Measurements
Sample from Tanzania, Mpwapwa.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	34·10	4·94	8·31	25·29	18·23	3·88	4·70	3·05
Range	32·3–36·8	4·8–5·2	7·7–8·9	23·7–27·8	17·7–19·2	3·7–4·1	4·6–4·8	2·8–3·2
S.D.	1·900	0·155	0·557	1·771	0·674	0·185	0·066	0·188
n	4	4	4	4	4	4	4	4
Females								
Mean	48·10	8·19	11·70	33·70	26·36	5·89	4·49	2·90
Range	47·0–49·2	8·0–8·4	10·1–13·1	32·0–34·6	25·9–27·3	5·5–6·4	4·1–4·8	2·4–3·4
S.D.	0·879	0·144	1·510	1·161	1·634	0·340	0·286	0·476
n	4	4	3	4	4	4	4	3

MATERIAL EXAMINED

Holotype ♂, **Tanzania**: Mpwapwa, Mt Wilkins, 1800 m, 1.xii.1948 (*Burtt*) (BMNH).

Paratypes. **Tanzania**: 2 ♂, 2 ♀, same data as holotype (BMNH); 1 ♀, Mpwapwa, Mt Wilkins, 1800 m, 10.iv.1938 (*Burtt*) (BMNH); 1 ♂, 1 ♀, Mpwapwa, Mt Kibariani, 1800 m, common, 3.xii.1948 (*Burtt*) (BMNH).

Gastrimargus miombo sp. n.

(Figs 52–56, 111, 136)

DIAGNOSIS. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; hind margin acutangular; dorsum of female with scattered globular warts. Tegmen surpassing folded hind knees by one-fifth to one-tenth of hind femur length in male; tegmen variable in female, sometimes failing to reach hind knees (Ufipa plateau). Genitalia (Figs 52–56) with strongly protruding aedeagus and large bulbous subapical ventral process. Ventral ovipositor valves with external lateral margin deeply excavated (Fig. 56).

Coloration typical for genus. Pronotal ×-marking with anterior and posterior arms similar in length and thickness, meeting at an angle of 90–120° (Fig. 136). Tegmen with distinct pale cross-banding. Hind wing with complete fascia (Fig. 136), widening anteriorly; basal area pale greenish yellow. Hind femur externally with or without indistinct oblique transverse bands. Internal surface straw-coloured; carinulae with dark dots. Hind tibia straw-coloured.

MEASUREMENTS

Sample from Central Africa, various localities.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	33·28	5·23	8·39	24·55	17·83	3·86	4·62	2·93
Range	29·7–39·6	4·7–6·0	7·4–9·4	21·7–29·6	15·9–21·5	3·3–4·3	4·3–5·1	2·5–3·3
S.D.	2·973	0·379	0·610	2·463	1·621	0·282	0·222	0·257
n	10	10	10	10	9	9	9	10
Females								
Mean	48·91	7·86	12·12	35·06	24·59	5·65	4·36	2·91
Range	44·8–53·2	7·1–9·4	10·1–15·3	30·8–38·6	21·6–28·0	5·1–6·4	4·0–5·0	2·0–3·4
S.D.	3·577	0·734	1·616	2·637	2·171	0·405	0·287	0·370
n	7	11	11	10	11	11	11	10

AFFINITIES. *G. miombo* is allied to *G. verticalis* and *G. determinatus* on the basis of the general form and coloration, especially the absence of dark pigment on the undersides of the hind femora, and the genital morphology. It may be distinguished by the characters outlined in the key.

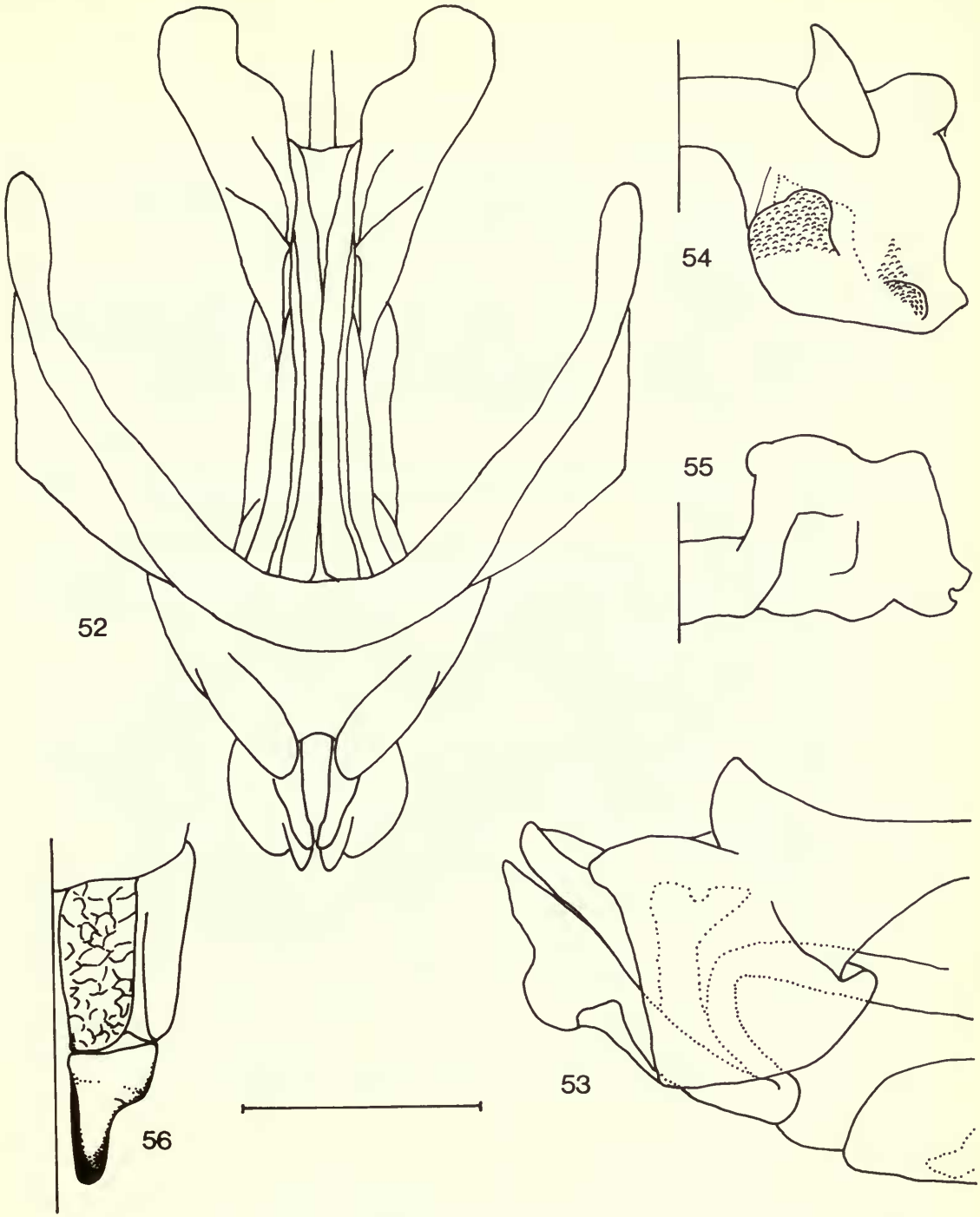
MATERIAL EXAMINED

Holotype ♂, **Angola**: Palavange, 2.xi.1930 (*Green*) (ANS, Philadelphia).

Paratypes. **Angola**: 3 ♂, 1 ♀, Palavange, 2.xi.1930 (*Green*) (ANS, Philadelphia); 1 ♀, Moxico distr., Valley of R. Mu-Simoj, 25.x.1927 (*Burr*). **Zambia**: 1 ♂, Abercorn, Zombe, Lombwe Place, 26.i.1961 (*Vesey-Fitzgerald*); 1 ♀, Broken Hill, ii.1931 (ANS, Philadelphia). **Tanzania**: 1 ♂, Ufipa, Chapota, 3.xii.1949 (*Vesey-Fitzgerald*); 1 ♀, same data, 4.xii.1949. **Zaire**: 1 ♂, Katanga, xi–xii.1927 (*Burr*); 1 ♀, Kapanga, ix.1933 (*Overlaet*) (MRAC, Tervuren); 1 ♂, 2 ♀, Lomani, Kishinde, x.1931 (*Quarré*) (MRAC, Tervuren); 1 ♂, Katanga, Kasompi, terr. Jadotville, radioactive hill, x.1956 (*Marlier, Laurent, Leleup*) (MRAC, Tervuren); 1 ♀, Lulua, Kapanga, ix.1932 (*Overlaet*) (MRAC, Tervuren).

DISTRIBUTION (Fig. 111, and Biogeography section, p. 312). Angola, Zaire, Zambia, Tanzania.

DISCUSSION. The specimen from Moxico, Angola, collected by Burr was incorrectly identified by Uvarov (1953: 114) as *G. brevipes* Sjöstedt.



Figs 52–56 *Gastrimargus miombo*, genitalia. 52, phallic complex, dorsal view; 53, same, posterior portion, lateral view; 54, epiphallus, right half, dorsal view; 55, same, posterior view; 56, ovipositor, left half, ventral view.

Gastrimargus determinatus (Walker, 1871)

(Figs 57–63, 115, 137–140)

Pachytylus determinatus Walker, 1871: 72.

This species is here divided into four subspecies under which the specific synonymy is separately listed.

DIAGNOSIS. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; dorsum with variable scattering of small shiny warts; hind margin sharply acutangular. Tegmen surpassing folded hind knees by one-sixth to one-quarter of hind femur length. Genitalia (Figs 57–63) with aedeagus strongly protruding; sub-apical ventral process large, bulbous; epiphallus with variable lateral plate and outer lobe of lophi slightly divergent.

Coloration variable. Pronotal ×-marking variable in emphasis, sometimes obsolete, with posterior arms of variable length and angle to anterior arms (90–160°). Tegmen light brown with pale cross-bands poorly contrasting (Figs 137–140). Hind wing fascia variable, present or absent according to subspecies (Figs. 137–140); basal area pale yellow. Hind femur externally with or without oblique banding, but always with internal and external upper and lower carinulae with row of black dots; medial and ventral areas of internal surface straw-coloured. Hind tibiae light greyish brown becoming reddish in apical half with black-tipped spines.

AFFINITIES. *G. determinatus* has affinities with *G. miombo* on the basis of the overall morphology, differing from it by the larger size, less contrasted coloration, and shorter cingular rami (see also characters in the key, p. 245).

DISTRIBUTION (Fig. 115, and Biogeography section, p. 310). *G. determinatus procerus* extends eastward and southward across Africa from Senegal to Ethiopia, Uganda and Angola. In eastern and southern Africa it is replaced by *G. d. vitripennis*, with some overlap and intergradation at the boundary. *G. d. determinatus* is probably restricted to Cape Province, but since the precise area is unknown it is not shown on the distribution map (Fig. 115).

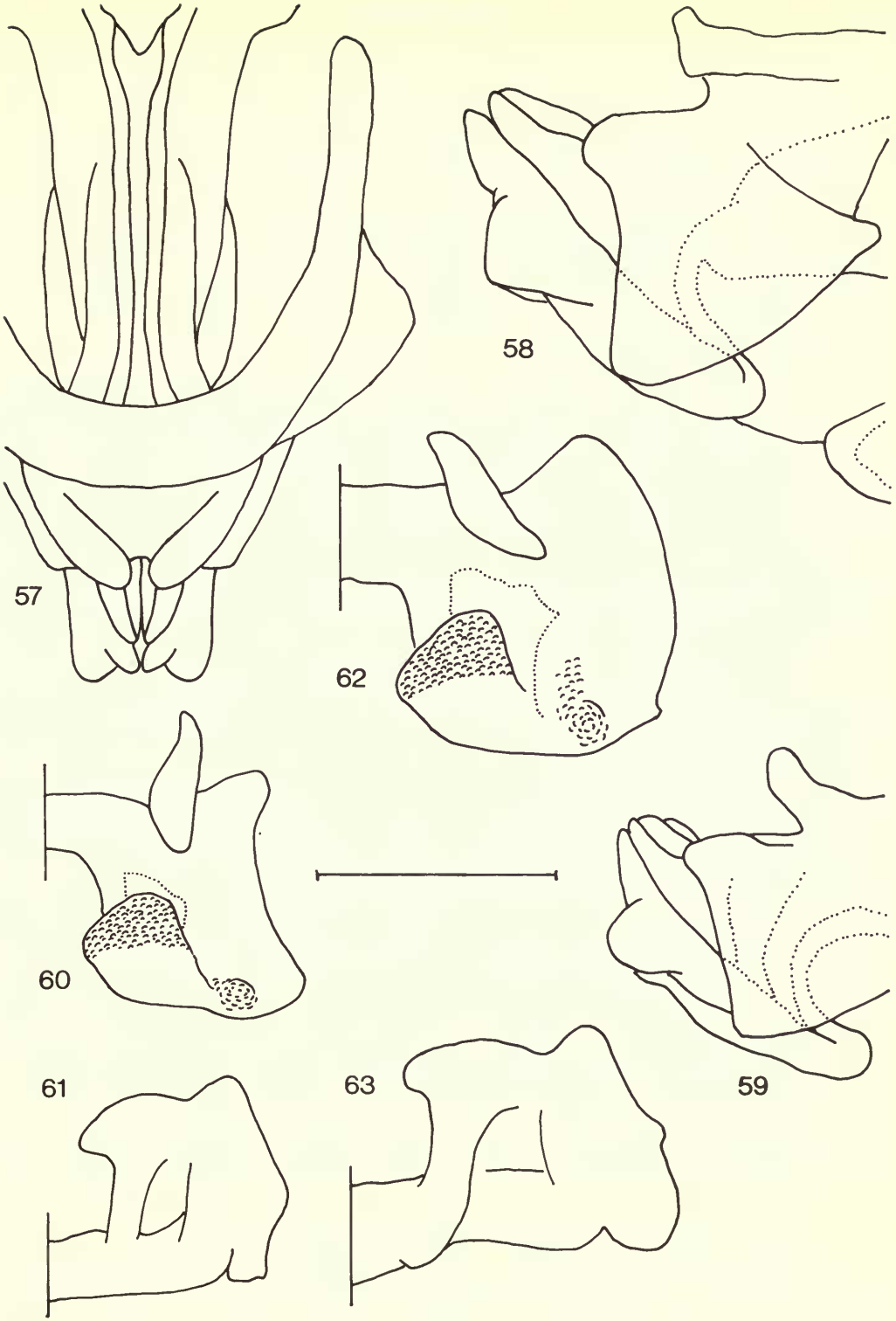
DISCUSSION. The variability of the coloration of *G. determinatus* led Sjöstedt (1928) to erect no less than 12 taxa based on material of the same species from different parts of Africa. The unique female holotype and the newly recognised unique male of *G. determinatus determinatus* are both labelled as from 'Cape', presumably indicating collecting sites in SW. Cape Province. However, the precise locality is unknown. Apart from the hind wing fascia this subspecies is identical with *G. determinatus vitripennis*. The intermediate stage in the loss of the fascia is represented by *G. determinatus procerus* in West Africa. The subspecific status of the partly banded race was first recognised by Uvarov (1926: 427) who described it as *G. volkensi nigericus*.

Dirsh (1961*a*) showed that *G. volkensi nigericus* is a junior synonym of *G. procerus* on the basis of the description of *procerus* and in the absence of the type which he stated was lost. I am informed by Dr K. K. Günther of Berlin and Dr G. Müller of Greifswald that the type is not in either collection. It is therefore certainly lost. To establish the synonymy a male specimen from Ghana has been chosen as neotype of *Oedaleus* (*Humbella*) *procerus* Gerstäcker.

The female lectotype of *G. determinatus determinatus* is specimen *a* of Walker's syntype-series *a–e*, and was recognised as the type by Uvarov who labelled it as such and sent a photograph of it to Sjöstedt for his revision of the genus (1928). Since all the remaining syntypes have been referred to other species or subspecies the lectotype is now the sole type-specimen available and it is formally designated to stabilise the nomenclature.

Key to subspecies of *G. determinatus*

1 Hind wing without fascia, but anal veins sometimes darkened medially (Fig. 138). 2
– Hind wing with partial fascia posterior to 2*A*, or with complete fascia (Figs 137, 139, 140) . . 3
2 Larger, longer-winged insects (tegmen length 26–32 mm ♂, 40–45 mm ♀) with pronotal pattern variable; ×-marking usually present (eastern and southern Africa)
G. determinatus vitripennis (Saussure) (p. 283)
– Smaller, shorter-winged insects (tegmen length 24–26 mm ♂, 36–40 mm ♀) with pronotal pattern fixed as two separate dark longitudinal bands on a straw-coloured background, flanking median carina; ×-marking absent in females (Arabia) . ***G. determinatus arabicus*** (Uvarov) (p. 285)



Figs 57–63 *Gastrimargus determinatus*, genitalia. 57, phallic complex, dorsal view, *G. d. procerus*; 58, same, posterior portion, lateral view, *G. d. determinatus*; 59, same, *G. d. procerus*; 60, epiphallus, right half, dorsal view, *G. d. procerus*; 61, same posterior view; 62, same, dorsal view, *G. d. determinatus*; 63, same, posterior view.

3 Hind wing fascia of male complete, narrowly interrupted between *Cu*2 and 1*A*, not following hind margin of wing beyond 6*A* (Fig. 139); fascia of female paler, and fading posteriorly (Fig. 140) (Cape Province) . . . . . ***G. determinatus determinatus*** (Walker) (p. 282)

– Hind wing fascia incomplete, widely interrupted, occupying posterior half of wing beyond 2*A* at greatest extent, often less advanced (all intermediates occur between this and the unfasciated subspecies *G. d. vitripennis*) (West and Central Africa) . ***G. determinatus procerus*** (Gerstäcker) (p. 282)

Gastrimargus determinatus determinatus (Walker, 1871)

Pachytylus determinatus Walker, 1871: 72. LECTOTYPE ♀, South Africa (BMNH), here designated [examined].
Gastrimargus determinatus (Walker) Kirby, 1902: 71.

Measurements
Unique male and female from SouthAfrica.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Holotype ♀	—	—	—	36·5	28·1	6·7	4·2	—
Unique ♂	—	5·7	8·6	28·8	22·4	4·7	4·77	3·2

Material examined
Pachytylus determinatus Walker, lectotype ♀, **South Africa**: 'Cape of Good Hope' (BMNH).
South Africa: 1 ♂, Cape of Good Hope, 1829 (*Reynaud*) (MNHN, Paris).

Gastrimargus determinatus procerus (Gerstäcker, 1889) **stat. n.**

Pachytylus determinatus var.; Walker, 1871: 72.
Oedaleus (*Humbella*) *procerus* Gerstäcker, 1889: 48. Holotype ♀, Ghana (lost). NEOTYPE ♂, Ghana (BMNH), here designated [examined].
Humbe procera (Gerstäcker) Kirby, 1910: 216.
Gastrimargus volkensi var. *nigericus* Uvarov, 1926: 437. Holotype ♂, Nigeria (BMNH) [examined]. [Synonymised with *G. procerus* by Dirsh, 1961a: 49.]
Gastrimargus amplus Sjöstedt, 1928: 16. Holotype ♀, Sierra Leone (NR, Stockholm) [examined]. [Synonymised with *G. procerus* by Dirsh, 1970: 496.]
Gastrimargus nigericus Uvarov; Sjöstedt, 1928: 17. [Synonymised by Dirsh, 1961: 49.]
Gastrimargus silvicola Sjöstedt, 1928: 17. Holotype ♂, Zaire (NR, Stockholm) [examined]. [Synonymised by Dirsh, 1970: 496.]
Gastrimargus vittatus Sjöstedt, 1928: 18. Holotype ♂, Zaire (NR, Stockholm) [examined]. **Syn. n.**
Gastrimargus foveolarum Sjöstedt, 1928: 19. Holotype ♀, Cameroun (MNHU, Berlin) [examined]. [Synonymised by Dirsh, 1970: 496.]
Gastrimargus foveolarum var. *immaculata* Sjöstedt, 1928: 20. Holotype ♀, Zaire (MRAC, Tervuren) [examined]. [Synonymised by Dirsh, 1970: 496.]
Gastrimargus testaceus Sjöstedt, 1928: 20. Holotype ♂, Cameroun (MNHU, Berlin) [examined]. **Syn. n.**
Gastrimargus procerus (Gerstäcker) Dirsh, 1961: 49.

Measurements
Sample from West Africa, various localities.

	Males							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	39·86	5·51	8·38	29·84	20·29	4·17	4·83	3·55
Range	34·1–45·1	5·0–6·0	7·4–9·1	25·0–34·1	17·7–24·0	3·7–4·5	4·5–5·2	3·2–3·9
S.D.	2·284	0·208	0·452	1·878	1·455	0·199	0·209	0·196
n	29	29	28	29	26	25	25	28

MEASUREMENTS—(*cont.*)

	Females							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	59·99	8·48	12·45	45·06	30·60	6·21	5·01	3·61
Range	55·9–63·6	7·4–9·6	10·7–13·7	42·3–47·3	26·9–35·0	5·7–6·8	4·6–5·5	3·3–4·0
S.D.	2·062	0·446	0·679	1·554	1·750	0·556	0·222	0·150
n	26	29	29	26	29	29	29	26

MATERIAL EXAMINED

Oedaleus (*Humbella*) *procera* Gerstäcker, neotype ♂, **Ghana**: Accra plain, Nungua, 2.xii.1959 (Jago) (BMNH, London). *Gastrimargus volkensi* var. *nigericus* Uvarov, holotype ♂, **Nigeria**: Azare, vii.1924 (*Lloyd*) (BMNH). *Gastrimargus amplus* Sjöstedt, holotype ♀, **Sierra Leone**: no data (NR, Stockholm). *Gastrimargus silvicola* Sjöstedt, holotype ♂, **Zaire**: Luluabourg (NR, Stockholm). *Gastrimargus vittatus* Sjöstedt, holotype ♂, **Zaire**: Boko district, (*Laman*) (NR, Stockholm). *Gastrimargus foveolarum* Sjöstedt, holotype ♀, **Cameroun**: Satsche, 12–21.v.1909 (*Riggenbach*) (MNHU, Berlin). *Gastrimargus foveolarum* var. *immaculata* Sjöstedt, holotype ♀, **Zaire**: Eala, 2.i.1921 (*Schouteden*) (MRAC, Tervuren). *Gastrimargus testaceus* Sjöstedt, holotype ♂, **Cameroun**: Mittel-Adamaoua, 300–500 m, m.ü.d. M.V. Garoua u. Rei Buba, n. Monti, x.1912 (*Houy*) (MNHU, Berlin).

In addition to the type-material listed above, 172 specimens of this subspecies were examined from the following localities: **Senegal**. Dakar. **Sierra Leone**: 1 ♂, no data (paratype of *G. amplus*) (NR, Stockholm); 1 ♀, no data (*Morgan*) (unique specimen of Walker's '*P. determinatus* var.'); 1 ♀, Jowati, 19.viii.1912 (*Simpson*) (paratype of *G. volkensi nigericus*); 1 ♂, Kayima, 25.vii.1912 (*Simpson*) (paratype of *G. volkensi nigericus*); 1 ♂, Mongheri, 15.ix.1912 (*Simpson*) (paratype of *G. volkensi nigericus*); Makeni; Freetown, Mt Aureol, 300 m; Njala; Karema. **Liberia**: Bomi hills, 380 m; Kakata; N. of Monrovia, Bomi hills, 8 km NE. of mines, Forest Reserve rest house; Zov; Firestone Plantation; 13 km NW. of Belefuanai, S. fork, St Paul R.; Marshall Terr.; Bindah; Bushrod I. **Ivory Coast**: Man to Danane road, nr Zo R. bridge. **Ghana**: Amedzofe; Anfeega; Volta Reg., Likpe Mate; E. Reg, Ofankor; E. Reg, Shai hills; Achimota; N. Reg, Damongo; Katamanso; Ifaks; between Takoradi and Axim; E. Reg., Legon, Botanical Gardens; W. Reg, 10 km NE. of Princes Town; Accra plain, Nungua; Trans Volta, Togoland, Amedzofe; 1 ♀, N. Terr., Sankwalla, 4–7.xi.1915 (*Simpson*) (paratype of *G. volkensi nigericus*). **Mali**: Middle Niger, Beninigeni; Bamako; Sikasso, Klela. **Nigeria**: 1 ♀, Azare, 1924 (*Lloyd*) (paratype of *G. volkensi nigericus*); 1 ♀, Azare, 1925 (*Lloyd*) (paratype of *G. volkensi nigericus*); Dikwa; Chad area, Kalkala; Sherifuri, nr Azare; Zaria, Samaru; Bauchi Prov., Udubo; 45 km SE. of Maiduguri; Igbogun. **Cameroun**: nr Mokolo; 3 ♂, Mittel-Adamaoua, 300–500 m m.ü. d. M, V. Garua u. Rei Buba, n. Monti, x.1912 (*Houy*) (paratype of *G. testaceus*) (MNHU, Berlin); Benüe unth. Garua. **Congo**: Goungouru, 24 km N. of Nola, middle Congo, 620 m; Oka middle Congo, 360 m. **Zaire**: L. Albert, Kasenyi; Gety, 1350 m; Mahagi Port; Kivu; Katanga, R. Lubidi; Nya Ngezi; Nyangchi, Bukavu; 1 ♂ Boko distr. (*Laman*) (paratype of *G. vittatus*) (NR, Stockholm); 1 ♀, Luluabourg, no data (paratype of *G. silvicola*) (NR, Stockholm); Garamba National Park, Pidigala; Bloando; Leopoldville. **Sudan**: Bahr el Ghazal, 1·6 km S. of R. Lol. **Ethiopia**: 1 ♀, no data ('one of Walker's series of *P. determinatus*') (paratype of *G. volkensi nigericus*); Kefa Prov, 9 km NE. of Gojeb R. Mission, 1350 m. **Uganda**: Tororo; Bukumi; R. Mayanja; Mabira Forest; Jinja; Ankole, Gayaza; Kampala; Tororo to Mbale road; Banda, Chagwe; Mawakota. **Angola**: Luimbale, Mt Moco, 1800–1900 m. **Locality unknown**: 1 ♀ (paratype of *G. volkensi nigericus*). **Zambia:** Mukapa Place, Mpumpu; Musosa.

Gastrimargus determinatus vitripennis (Saussure, 1888) **stat. n.**

Oedaleus (*Gastrimargus*) *vitripennis* Saussure, 1888: 38. Holotype ♀, SOUTH AFRICA (MHN, Geneva) [examined].

[*Oedaleus* (*Gastrimargus*) *acutangulus* (Stål); Saussure, 1884: 109, 114; 1888: 39. Misidentifications: Sjöstedt, 1928: 43.]

Gastrimargus vitripennis (Saussure) Kirby, 1902: 233.

Gastrimargus volkensi Sjöstedt, 1909: 171. Holotype ♀, TANZANIA (NR, Stockholm) [examined]. **Syn. n.**

Gastrimargus fallax Sjöstedt, 1928: 24. Holotype ♀, TANZANIA (MNHU, Berlin) [examined]. **Syn. n.**

Gastrimargus volkensi var. *minor* Sjöstedt, 1928: 44. Holotype ♀, KENYA: Victoria Nyanza, Sesse Is., Bugala, vii.08 (*Bayon*) (MCSN, Genoa). [Synonymised with *G. volkensi* by Dirsh, 1966: 429.]

Gastrimargus volkensi var. *minor* forma *rectinotum* Sjöstedt, 1928: 44. Holotype ♀, KENYA: Bugala (MCSN, Genoa). [Unavailable infrasubspecific name.] [Synonymised by Dirsh, 1966: 429.]

Gastrimargus pallidus Sjöstedt, 1928: 45. Holotype ♀, KENYA: Victoria Nyanza, Sesse Is., Bugala, 1908 (*Bayon*) (MCSN, Genoa). **Syn. n.**

Gastrimargus femoralis Sjöstedt, 1928: 45. Holotype ♀ SOUTH AFRICA (BMNH) [examined]. [Synonymised with *G. volkensi* by Dirsh: 1961*b*: 395.]

MEASUREMENTS

Sample from Zimbabwe.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	40·03	5·86	8·85	29·36	21·13	5·03	4·21	3·31
Range	35·4–43·2	5·2–6·3	7·9–10·1	26·0–32·2	18·5–23·4	4·5–5·5	3·9–4·6	3·1–3·6
S.D.	1·786	0·304	0·477	1·459	1·093	0·270	0·164	0·137
n	15	20	20	17	20	20	20	17
Females								
Mean	57·15	8·78	12·98	41·94	29·87	6·87	4·36	3·23
Range	54·4–60·7	8·2–9·7	12·0–14·4	39·7–45·1	27·80–32·0	6·2–7·7	4·1–4·9	3·0–3·5
S.D.	1·933	0·338	0·695	1·560	1·317	0·325	0·218	0·142
n	19	22	22	19	22	22	22	19

MATERIAL EXAMINED

Oedaleus (*Gastrimargus*) *vitripennis* Saussure, holotype ♀, **South Africa**: Cape of Good Hope (*Delalande*) (MHN, Geneva). *Gastrimargus volkensi* Sjöstedt, holotype ♀, **Tanzania**: Meru (lowland), Ngare na Nyuki, i. (*Sjöstedt*) (NR, Stockholm). *Gastrimargus fallax* Sjöstedt, holotype ♀, **Tanzania**, no data (MNHU, Berlin). *Gastrimargus femoralis* Sjöstedt, holotype ♀, South Africa: [Transvaal, Pretoria,] Masil nek (*Distant*) (BMNH).

In addition to the type-material listed above, 251 specimens of this subspecies were examined from the following localities: **Ethiopia**: Harerge Prov., 33 km N. of Asbe Teferin, NE. of Meisso; nr Addis Alem, 2250 m; Addis Ababa to Debra Marcos road, Abbai Gorge, 2100 m; Nefasit; Adteclesan; El Oha; Addis Taffari, 1740 m; Meisso, nr station; L. Zwai; Addis Ababa to Dessye road, S. of Karacori, 1500 m. **Kenya**: Moyale, NFD; Emali range, Sultan Hamud, 1470–1770 m; Marsabit; CRS, Tebere, 00°39·5′S 37°23′E; 4 km N. of Kitui, 01°08·5′S 37°44′E; Embu distr, 00°41′S 37°28′E; Meru Nat Pk, 00°01′N 38°04′E; Chyulu hills, 02°38·5′S 37°51·5′E; Thika; Nairobi; Lodwar, Rabai; Shimba hills; Kasigau; 1 ♀, Victoria Nyanza, Sese Arch., Bugala, vii.1908 (*Bayon*) (paratype of *G. volkensi minor*) (NR, Stockholm); 1 ♀, same data (paratype of *G. pallidus*) (NR, Stockholm); 20 km N. of Isiolo; Kitito coffee estate, 00°58′S 37°17′E, 1560–1620 m, Taita Hills Lodges game area, 03°32′S 38°14′E, 920 m; Mwangaro (Lion Rock), 03°33′S 38°11′E, 930 m; top of Marinduko hill, 5 km S. of Embu town, 00°35′S 37°27′E, 1385 m; Salt Lick Lodge, 03°33′S 38°13′E, 870 m. **Uganda**: 1 ♀, Ankole, Lwasamaine; Katwe; Masaka, Lwengo; Entebbe; Kepeka; Tororo to Jinja; Mawakota; Koki Lwanda; Mwani; Mabira forest; L. George. **Tanzania**: Old Shinyanga; Ukiriguru, Lake Prov; Tabora; Singida; Mkwemi, Kahama; Dar-es-Salaam; Ufipa plateau; Ilonga; Oldeani distr.; Kigoma; Kilosa; Morogoro; Uluguru Mts; Mkawa, Iringa; Mikumi Nat. Pk. **Malawi**: Kondowe to Karonga. **Zambia**: Kabundi forest, Chingola; Fort Jameson to Nyanji, 900–1050 m; Luano valley, Mulungushi; Luano valley, Chisorwe; Kalulu; Mporokoso distr., Mweru Wa Ntipa; Abercorn, Chiyanga. **Zaire**: Gety, 1350 m; Kasenyi, Petros village; Ituri distr., N'dele; 1 ♂, Plaine du Parc National Albert, 1933 (*Lëopold*) (incorrectly labelled as allotype of *G. volkensi* var. *minor*) (IRSNB, Brussels). **Angola**: 13 km NE. of Cacula; Moxico distr., Huamba. **Zimbabwe**: Salisbury, Mashonaland, 1500 m; Selukwe, 1420 m; Umvukwes, 1500 m; Magunje, 16°50′S 29°26′E; Odzi distr.; Amandas, 1260 m; Vuti, 16°30′S 29°30′E; Umtebekwe R., 900 m. **Botswana**: Lobatse area. **Namibia**: Regenstein, 24 km SSW of Windhoek. **South Africa**: Transvaal, SW.

Waterburg distr.; Tvl, Reitspruit, Mauco; Tvl, Kliprieversburg, 24 km S. of Johannesburg; Tvl, Rustenburg; Tvl, Zoutpansberg distr., Kobehpan Kopjes, 720 m; Tvl, Johannesburg; Tvl, E. Johannesburg, Bedford Ridge; Tvl, Constantia ranch, 5 km S. of Kaapmuiden; Tvl, Pretoria; Tvl, Barberton; Tvl, Watervaal; Natal, Durban; Natal, Zululand, Conjeni; Natal, Pinetown; Natal Nat. Pk; Natal, Ingogo; Cape Province, Swellendam; C.P., Cape of Good Hope; C.P., Mafeking.

Gastrimargus determinatus arabicus Uvarov, 1936

Gastrimargus volkensi arabicus Uvarov, 1936: 542. Holotype ♂, YEMEN: Sanaa, vii.31 (*Rathjens*) (ZM, Hamburg).

MEASUREMENTS

Sample from Arabia.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	33·84	4·82	6·78	24·92	17·52	3·91	4·48	3·68
Range	32·4–34·9	4·4–5·1	6·1–7·2	23·8–25·6	16·7–18·5	3·7–4·2	4·3–4·6	3·5–3·9
S.D.	0·824	0·227	0·383	0·560	0·614	0·182	0·117	0·149
n	8	8	9	9	7	7	7	9
Females								
Mean	51·98	8·48	11·48	37·68	27·96	6·35	4·40	3·20
Range	49·4–55·2	8·1–8·9	10–3–12·4	36·0–40·1	26·2–29·2	6·0–6·7	4·2–4·6	2·4–3·8
S.D.	1·857	0·238	0·662	1·586	1·109	0·220	0·156	0·371
n	8	8	9	9	7	7	7	9

MATERIAL EXAMINED

Saudi Arabia: 1 ♀, 2 nymphs, Baha, 7.vi.1969 (*Popov*); 5 ♂, 3 ♀, Alaya to Baha, 11.vi.1972 (*Popov*) (COPR, London); 1 ♀, nr Baha, 16.x.1971 (*Popov*) (COPR, London). **Southern Yemen**: 1 ♀, Dhala, x.1935 (*Darling*) (paratype of *G. volkensi arabicus*); 5 ♀, Jebel Jihaf, Wadi Leje [or Lejij], *c.* 2040 m, 13–15.x.1937 (*Scott & Britten*); 3 ♂, same data, *c.* 2130 m, x.1937; 1 ♂, same data, *c.* 2100 m, 1.x.1937; 1 ♂, same data, 6.x.1937; 1 nymph, Jebel Feifa, 17°15′N, 43°05′E, 900 m, 1946 (*Popov*). **Oman**: 1 ♀, Dhofar, Jebel Quarra, 30.x.1943 (*Fitzgerald*); 2 ♂, 3 nymphs, same data, x.1943; 3 nymphs, same data 2.x.1943; 1 ♀, Jebel Quarra, 20–29.x.1945 (*Thesiger*).

Gastrimargus crassicollis (Saussure, 1888)

(Figs 64–67, 112, 141)

Oedaleus (*Gastrimargus*) *crassicollis* Saussure, 1888: 38. Holotype ♀, SOUTH AFRICA (MHN, Geneva) [examined]. [Incorrectly attributed by Saussure to Blanchard.]

[*Oedaleus assimilis* Thunberg; Kirby, 1910: 226. Misidentification.]

Gastrimargus transvaalensis Sjöstedt, 1928: 25. Holotype ♀, SOUTH AFRICA (MNHN, Paris) [examined]. **Syn. n.**

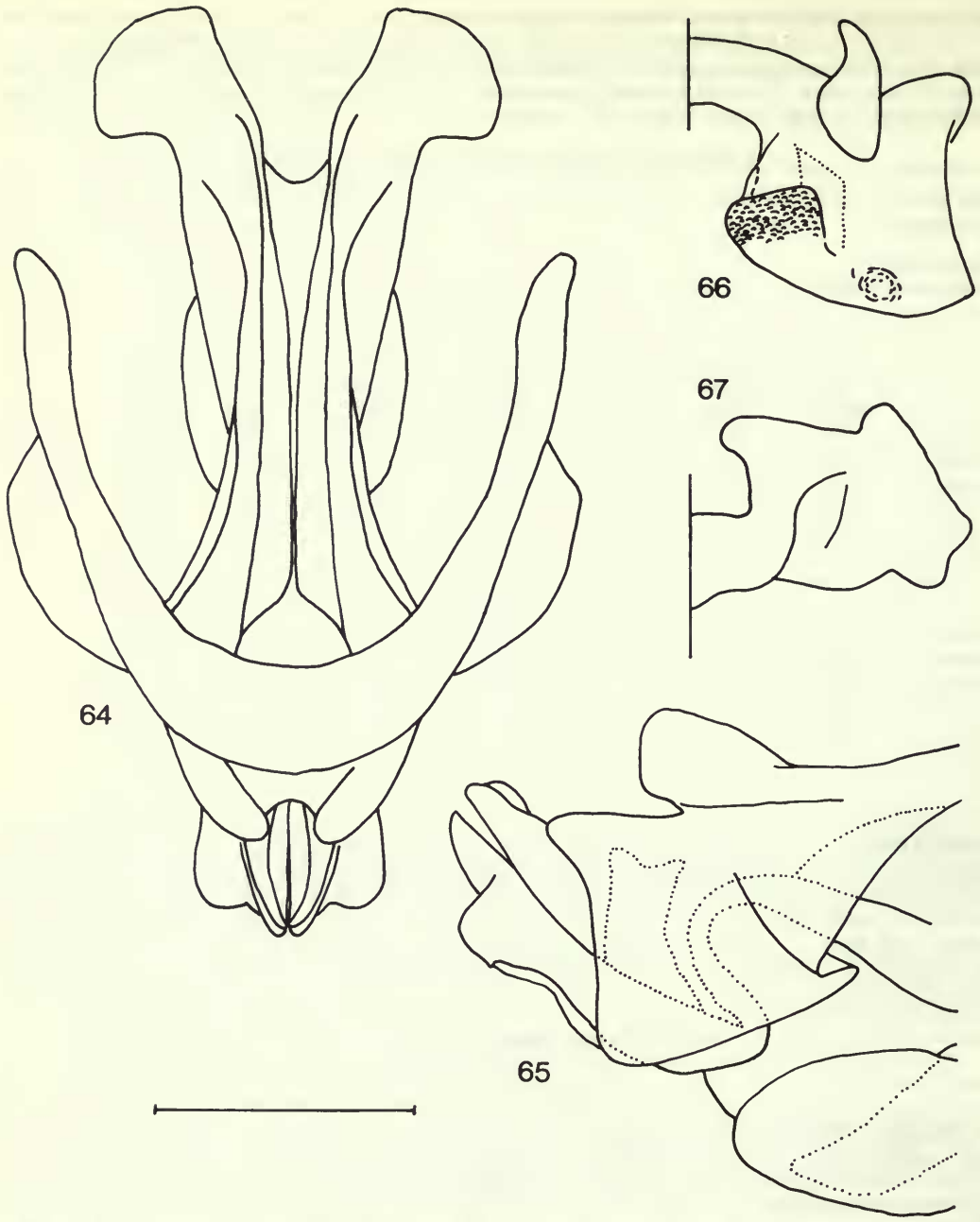
Gastrimargus crassicollis (Saussure) Sjöstedt, 1928: 27.

Gastrimargus clepsydrae Sjöstedt, 1928: 29. Holotype ♀, SOUTH AFRICA (ZM, Hamburg) [examined]. **Syn. n.**

Gastrimargus crassipes Sjöstedt, 1928: 29. Holotype ♀, SOUTH AFRICA (MNHU, Berlin) [examined]. **Syn. n.**

Gastrimargus grossiceps Sjöstedt, 1931: 25. Holotype ♀, 'Sumatra' [locality data incorrect] (NR, Stockholm) [examined]. **Syn. n.**

DIAGNOSIS. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; dorsum with a few small globular warts; hind margin sharply or bluntly acutangular. Tegmen variable, surpassing folded hind knees by one-quarter to one-half of hind femur length in male, less in female. Genitalia (Figs 64–67) similar to *G. miombo* and *G. determinatus*, with short cingular rami, strongly protruding aedeagus, and large subapical ventral process; epiphallus as in *G. d. procerus*.



Figs 64–67 *Gastrimargus crassicollis*, genitalia. 64, phallic complex, dorsal view; 65, same, posterior portion, lateral view; 66, epiphallus, right half, dorsal view; 67, same posterior view.

Coloration typical for genus. Pronotal ×-marking variable in thickness and emphasis, sometimes almost obsolete. Tegmen with two pale transverse bands. Hind wing fascia (Fig. 141) complete, of variable width, curving inwards along anal margin in male; in female sometimes faded or obsolete in posterior part of anal area, appearing less curved than male; basal area of wing bright sulphur yellow. Hind femur externally with 2–3 oblique transverse bands; internal surface with basal half of medial area blackish; external and internal upper and lower carinulae with row of irregular black dots; internal ventral carinula and ventral surface of hind femur tinted with blue-grey of variable depth in male, blue-grey to straw-coloured in female. Hind tibiae red.

MEASUREMENTS
Sample from various localities, southern Africa.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	31·42	4·95	6·66	22·93	17·28	4·29	4·05	3·45
Range	27·9–35·8	4·4–5·7	6·0–7·9	20·0–26·8	15·3–19·7	3·5–5·0	3·5–4·7	3·2–3·7
S.D.	1·733	0·312	0·467	1·458	1·066	0·332	0·334	0·127
n	30	30	30	30	30	30	30	30
Females								
Mean	44·12	7·51	9·76	31·78	23·90	6·01	4·00	3·26
Range	38·6–50·0	6·4–8·4	8·4–11·0	26·7–37·5	21·4–27·3	5·1–6·9	3·6–4·5	3·0–3·5
S.D.	2·839	0·546	0·715	2·226	1·444	0·499	0·276	0·163
n	25	30	30	30	30	30	30	30

AFFINITIES. *G. crassicollis* is allied to *G. drakensbergensis* in general appearance, though less sombre in colour, and with a longer aedeagus, similar to that of *G. determinatus* and *G. verticalis.*

MATERIAL EXAMINED

Oedaleus (*Gastrimargus*) *crassicollis* Saussure, holotype ♀, **South Africa**: Cape of Good Hope, no further data (MHN, Geneva). *Gastrimargus transvaalensis* Sjöstedt, holotype ♀, **South Africa**: Transvaal, 1902 (*Bel*) (MNHN, Paris). *Gastrimargus clepsydrae* Sjöstedt, holotype ♀, **South Africa**: Transvaal, Johannesburg, 4.x.1902 (*Willvend*) (ZM, Hamburg). *Gastrimargus crassipes* Sjöstedt, holotype ♀, **South Africa**: Grahamstown, i.1891 (*Schömand*) (MNHU, Berlin). *Gastrimargus grossiceps* Sjöstedt, holotype ♀, 'Sumatra: Solok, (*Stole*)' [incorrect locality data], (NR, Stockholm).

South Africa: 1 ♀, Transvaal, Johannesburg (*Brogan*); 3 ♂, 1 ♀, Tvl, Johannesburg, 12.xi.1950 (*Balinsky*); 1 ♀, same data, 23.xii.1950; 1 ♂, Tvl, E. Johannesburg, Bedford Ridge, 26.1.1949 (*Capener*); 1 ♀, same data, 2.iii.1949; 2 ♂, 1 ♀, Tvl, S. Johannesburg, 2.iv.1939 (*Ramsay*); 3 ♂, 3 ♀, Tvl, Pretoria (*Distant*); 1 ♂, 1 ♀, Pretoria, 10.i.1914; 1 ♀, Pretoria (*Donavan*); 1 ♂, 1 ♀, Pretoria, 12.iv.1918; 1 ♂, Pretoria, 26.iii.1932 (*Geyer*) (ANS, Philadelphia); 1 ♀, 29.iii.1925 (ANS, Philadelphia); 1 ♂, Pretoria, 4.iii.1921 (ANS, Philadelphia); 1 ♀, Pretoria, 5.i.1959 (*Venter*) (DATS, Pretoria); 1 ♂, Pretoria, 4.iii.1921 (DATS, Pretoria); 7 ♂, 3 ♀, Tvl, 8 km E. of Dalmanutha, 1680 m, 24.i.1974 (*Middlekauff*) (CAS, San Francisco); 1 ♂, Tvl, Ocueefsdorp, 12.iv.1951 (*Botha*) (DATS, Pretoria); 1 ♀, Tvl, Humansdorp, iii.1933 (TM, Pretoria); 1 ♀, Natal, Yellow Woods, Balgowan, 2.iv.1960 (*Dickson*) (TM, Pretoria); 1 ♂, Natal, Zululand, St Lucia, 9.v.1944 (*Staden*) (DATS, Pretoria); 6 ♂, 1 ♀, Natal, Drakensberg Mts, Giant's Castle, 1957 (*Jago*) (COPR, London); 2 ♀, Natal, Underberg, 1–29.ii. (*Ilsley*) (COPR, London); 3 ♂, 3 ♀, Natal, Venters Kroon, 2.v.1911 (ANS, Philadelphia); 1 ♂, same data, 1.v.1911 (ANS, Philadelphia); 1 ♀, Natal, Makokoane, 18.1.1932 (*Jacquot-Guillarmod*) (ANS, Philadelphia); 1 ♀, no data (ANS, Philadelphia); 1 ♀, Natal, Mamathes (*Jacquot-Guillarmod*) (ANS, Philadelphia); 1 ♂, Natal, Louwsburg, 18.i.1969 (*Rensburg*) (DATS, Pretoria); 1 ♂, Natal, Zululand, Hluhluwe, 600 m, iv.1946 (*Buxton*); 1 ♂, Natal, Pietpotgietersrust, 13.iv.1906; 1 ♂, Orange Free State, 7 mls E. of Clarens, 23.ii.1962 (*Brown & Fürst*) (DATS, Pretoria); 1 ♀, O.F.S., Witzieshoek, 1830 m, 24.ii.1929 (*Scott*); 2 ♀, O.F.S., Gum Tree, ii.1932 (*Ogilvie*); 2 ♂, 4 ♀, O.F.S., Orange R. Colony (*B.-Hamilton*); 2 ♂, O.F.S., Harrismith, 1–20.iii.1927; 1 ♀, Cape Province, Knysna, no further data; 1 ♀, C.P., 22 mls W. of Cofimvaba, 940 m, 14.iv.1958 (*Ross & Leech*) (CAS, San Francisco); 1 ♂, C.P., Knysna, Concordia, (*Longstaff*) (UM, Oxford); 1 ♀, C.P., Humansdorp, iii.1933 (DATS, Pretoria); 1 ♀, C.P., Cape of Good Hope (*Peringuey*) (MHN, Geneva); 1 ♂, C.P., Cape of Good Hope (*Brady*) (MHN, Geneva); 1 ♂, 1 ♀, C.P., Jeffraes Bay, 24.i.61, (*Lea*) (DATS, Pretoria); 2 ♀, C.P., Mt Fletcher, *c.* 1500 m, in open veldt, 28.iii.1954 (*Balfour-Browne*); 4 ♂, C.P., Queenstown, 1050 m, 16.i–10.ii.1923 (*Turner*); 1 ♂, 1 ♀, C.P., Katberg, 1–18.ii.1933 (*Turner*); 2 ♀, C.P., Bizana, Pondoland E., i.1932 (*Key*); 6 ♂, 2 ♀, C.P., Grahamstown, 23.ii.1955 (*Greathead*); 1 ♀, C.P., Swellendam, ii.1932; 1 ♀, C.P., Swellendam, 17.xii.1931–18.i.1932 (*Turner*); 1 ♀, C.P., 15 mls ENE. of Mt Frère, 6.iii.1951 (*Brinck & Rudebeck*); 1 ♀, C.P., Eland's Height, 15 mls SW. of Mt Fletcher, 9.iii.1951 (*Brinck & Rudebeck*). **Lesotho**: 1 ♂, Simonkong, 23.ii.1959 (*Brown*) (DATS, Pretoria); 2 ♂, Quthing, Mt Hodimonate,

12.iii.1951 (*Brinck & Rudebeck*); 1 ♂, Maluti Mts, Nyakoesuba, 2000 m, 18–19.ii.1929 (*Scott*); 1 ♂, Nazareth M.S., 32 km ESE. of Maseru, 26.iii.1951 (*Brinck & Rudebeck*); 1 ♂, Mt Machache, 40 km E. of Maseru, 25.iii.1951 (*Brinck & Rudebeck*); 1 ♂, Blue Mountain Pass, Maloti Mts, 16.i.1973 (*Vári*) (TM, Pretoria). **Botswana**: 1 ♀, no data. **Zimbabwe**: 1 ♂, Selukwe, 1420 m, 19.iv.1935 (*Miller*); 1 ♀, Vumba, 10–15.xii.1937 (*Van Son*) (TM, Pretoria).

DISTRIBUTION (Fig. 112, and Biogeography section, p. 308). Zimbabwe, Lesotho, South Africa. The record from pasture in Kenya (Zacher, 1917) is erroneous.

DISCUSSION. The holotype female of *G. crassicollis* is a small discoloured specimen in poor condition. This may partly explain why Sjöstedt (1928) failed to associate any of his material with this species. *G. crassicollis* varies greatly in general coloration, and Sjöstedt mistakenly erected new species on the basis of this variability.

Gastrimargus drakensbergensis sp. n.

(Figs 68–71, 112, 142)

DIAGNOSIS. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; dorsum in female with sparse globular warts. Tegmen surpassing folded hind knees by one-seventh to one-eighth of hind femur length. Genitalia (Figs 68–71) somewhat similar to those of *G. africanus* with very short weakly projecting aedeagus.

Coloration generally sombre dark brown. Pronotal ×-marking variable, sometimes obsolete, especially in males. Hind wing fascia complete, of variable width, widening anteriorly (Fig. 142); basal area of wing pale greenish yellow. Hind femur with row of irregular brown dots on external and internal upper and lower carinulae, sometimes absent in males, and with 2–3 variable oblique cross-bands on external medial area; internal surface in male with medial area black, becoming blue-black on ventral surface; female with black area on internal surface reduced or absent, and ventral surface straw-coloured. Hind tibiae reddish.

MEASUREMENTS
Sample from South Africa.

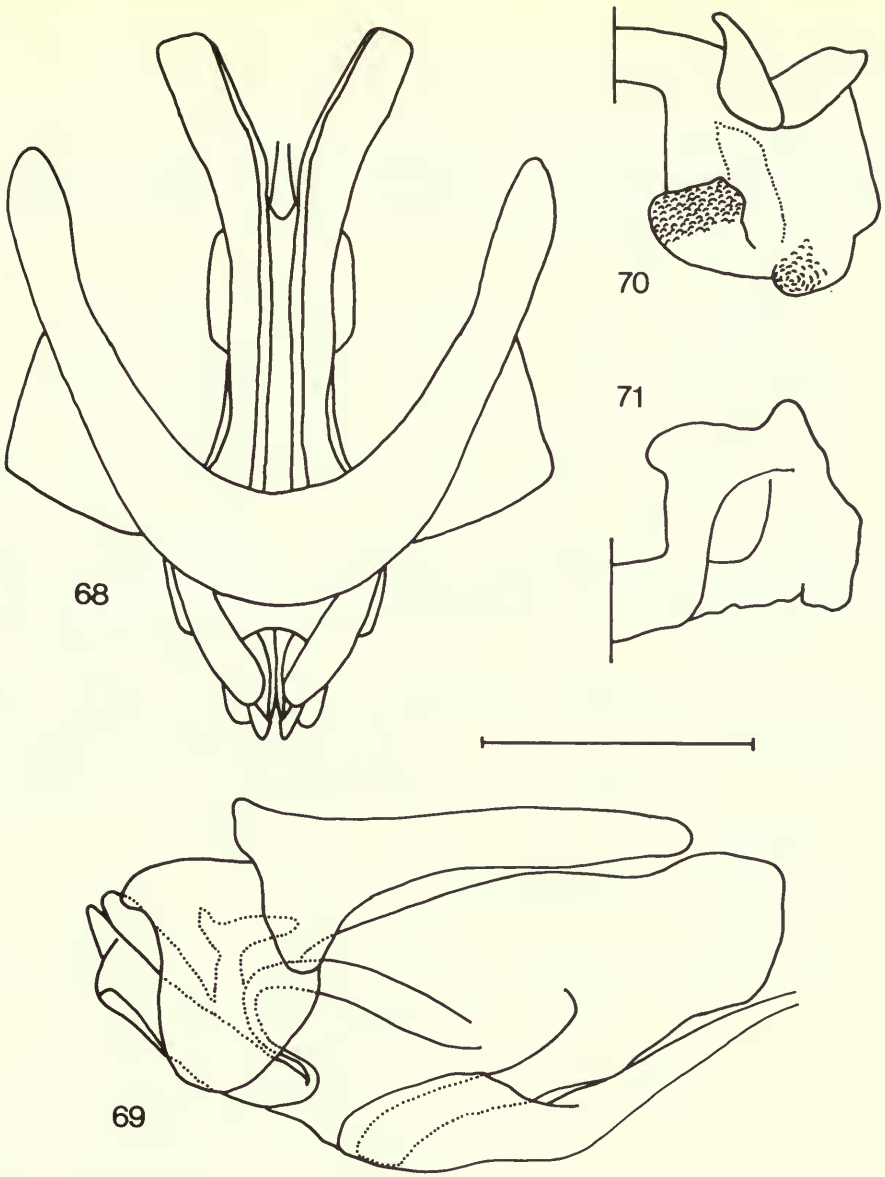
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	32·84	5·00	7·25	23·91	17·96	4·16	4·33	3·31
Range	29·7–36·1	4·6–5·3	6·5–7·7	21·4–27·1	16·3–19·8	3·7–4·5	4·1–4·7	3·1–3·6
S.D.	1·641	0·185	0·416	1·491	0·790	0·218	0·186	0·162
n	13	14	13	14	14	14	14	13
Females								
Mean	41·59	6·93	9·28	30·03	23·08	5·38	4·29	3·21
Range	38·7–46·4	6·5–7·1	8·6–10·1	27·4–31·0	20·9–26·2	5·0–5·8	4·0–4·8	2·9–3·5
S.D.	1·939	0·204	0·422	1·756	1·309	0·247	0·224	0·161
n	12	12	12	12	12	12	12	12

AFFINITIES. *G. drakensbergensis* is allied to *G. crassicollis*, differing by the darker coloration and absence of bright yellow colour in the hind wing. These are characteristic features of adaptation to montane habitats. The aedeagus in this species is distinctly shorter than that of *G. crassicollis* (Figs 69, 65). Measurements of the two species are similar.

MATERIAL EXAMINED

Holotype ♂, **South Africa**: Natal, Drakensberg Mts, Giant's Castle, 1957 (*Jago*) (BMNH).

Paratypes. **South Africa**: 3 ♂, 5 ♀, same data as holotype (BMNH); 1 ♂, Natal, Drakensberg, Van Reenen, 1–22.i.1927; (*Turner*) (BMNH); 1 ♂, Natal, Van Reenen's Pass, 13.xii.1958 (*Dickson*) (BMNH); 1 ♂, Natal,



Figs 68–71 *Gastrimargus drakensbergensis*, genitalia. 68, phallic complex, dorsal view; 69, same, lateral view; 70, epiphallus, right half, dorsal view; 71, same, posterior view.

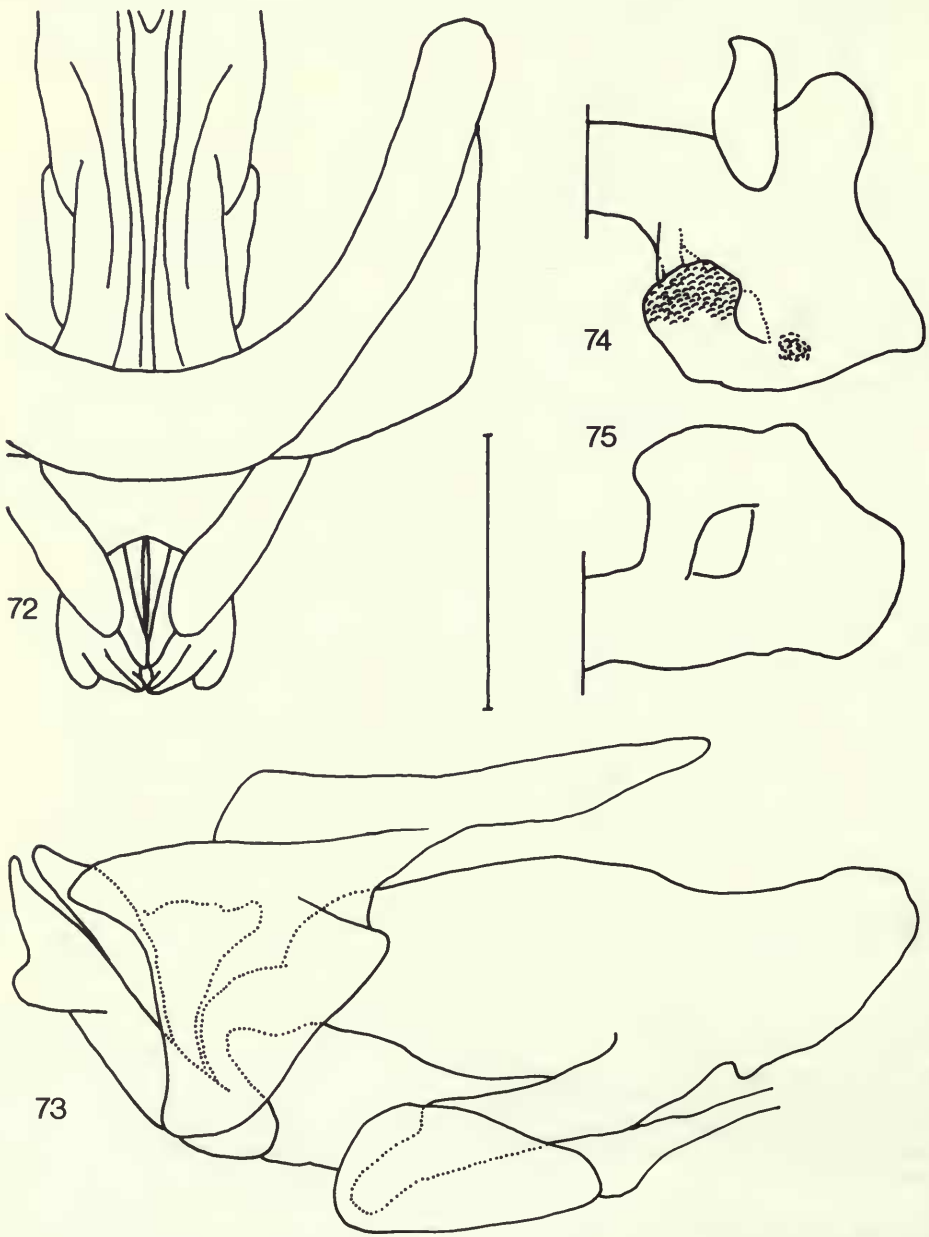
Drakensburg Nat. Pk., 21–2400 m, 27.i.1929 (*Scott*) (BMNH); 2 ♀, Natal, Yellow Woods, Balgowan, 18–28.ii.1960 (*Van Son*) (TM, Pretoria); 1 ♂, Transvaal, N., The Downs, 40 km S. of Tzaneen, 30.iv.1963 (*White*) (DATS, Pretoria); 1 ♂, Tvl, E., 5 km E. of Graskop, 11.x.1964 (*Snyman*) (DATS, Pretoria); 1 ♀, Tvl, Somerset West, 31.xii.1958 (*Dickson*) (TM, Pretoria); 1 ♀, Tvl, Woodbush, i.1923 (*Roberts*) (TM, Pretoria); 1 ♂, Tvl, E., 6 km W. of Graskop, 12.xi.1964 (*Snyman*) (DATS, Pretoria); 1 ♂, same data (*Brown*) (DATS, Pretoria); 1 ♀, Tvl, Jessievale, 58 km E. of Carolina, 18.xi.1970 (*Veenemans*) (DATS, Pretoria); 1 ♂, Tvl, E., 5 km E. of Graskop, 11.xi.1964 (*Brown*) (DATS, Pretoria); 2 ♂, Tvl, Barberton, xi.1902 (*Gould*) (ANS, Philadelphia); 1 ♂, 1 ♀, Tvl, Magoeba's Kloof, nr Tzaneen, Drakensburg Mts, 1200 m, 16.xi.1950 (*Orr*) (ANS, Philadelphia); 1 ♀, Tvl, Pretoria, 26.xii.1913 (BMNH); 2 ♂, Cape Province, Swellendam, 17.xii.1931–18.i.1932 (*Turner*) (BMNH).

DISTRIBUTION (Fig. 112, and Biogeography section, p. 308). South Africa.

Gastrimargus obscurus sp. n.

(Figs 72–75, 111, 143, 144)

DIAGNOSIS. Antennae of male lacking. Fastigium of vertex slightly concave, with triangular foveolae. Pronotum with median carina high arcuate, sometimes inflated in prozona, irregular in dorsal view, not intersected by posterior sulcus; median carina and vicinity distinctly rugose; hind margin rounded acutangular. Tegmen surpassing folded hind knees by one-fifth of hind femur length in male, less in female. Genitalia (Figs 72–75) with aedeagus strongly protruding and with large subapical ventral process; epiphallus with outer lobe of lophi small and rounded.



Figs 72–75 *Gastrimargus obscurus*, genitalia. 72, phallic complex, dorsal view; 73, same, lateral view; 74, epiphallus, right half, dorsal view; 75, same, posterior view.

Coloration unusual for genus, blackish brown with lighter markings. Pronotum with blackish ground colour; light ×-marking with posterior arms much thicker than anterior arms (Fig. 143). Tegmen dark in basal half, with reduced transverse bands three-eighths and five-eighths along from base (Figs 143, 144); apical half dark in male, lighter speckled in female. Hind wing with fascia complete, narrowly interrupted between *Cu*2 and 1*A*; basal area pale greenish yellow, apical half of wing with dark shading and darkened veins in male, paler in female. Hind femur externally with two oblique cross-bands in medial and upper marginal areas; chevron pattern of sulci in medial area and external lower marginal area blackish brown; internal surface mostly black continued on ventral surface. Hind tibiae red.

MEASUREMENTS
Sample from Zaire and Angola.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Holotype ♂	33·0	5·2	8·6	23·7	16·4	3·6	4·6	2·8
Paratype ♀	38·9	8·0	10·9	25·6	20·4	5·4	3·8	2·3
Paratype ♀	40·1	7·7	11·6	27·3	21·3	5·5	3·9	2·4

AFFINITIES. *G. obscurus* is allied to *G. angolensis* by the infuscate apical half of the hind wing, the form of the pronotal ×-marking, and the heavily pigmented ventral surface of the hind femur. The degree of rugosity of the pronotum, the generally very dark coloration, and the small rounded outer lobe of the lophi are, however, distinctive characters for this species.

MATERIAL EXAMINED
Holotype ♂, **Angola**: Bihé Distr., Chitau, 1470 m, 13.i.1931 (*R. & L. Boulton*) (ANS, Philadelphia).
Paratypes. **Angola**: 1 ♀, same data as holotype (ANS, Philadelphia). **Zaire**: 1 ♀, Katanga, Kipopo (Elizabethville), 11.i.1962 (*Marêchal*) (MRAC, Tervuren).

DISTRIBUTION (Fig. 111, and Biogeography section, p. 312). Angola, Zaire.

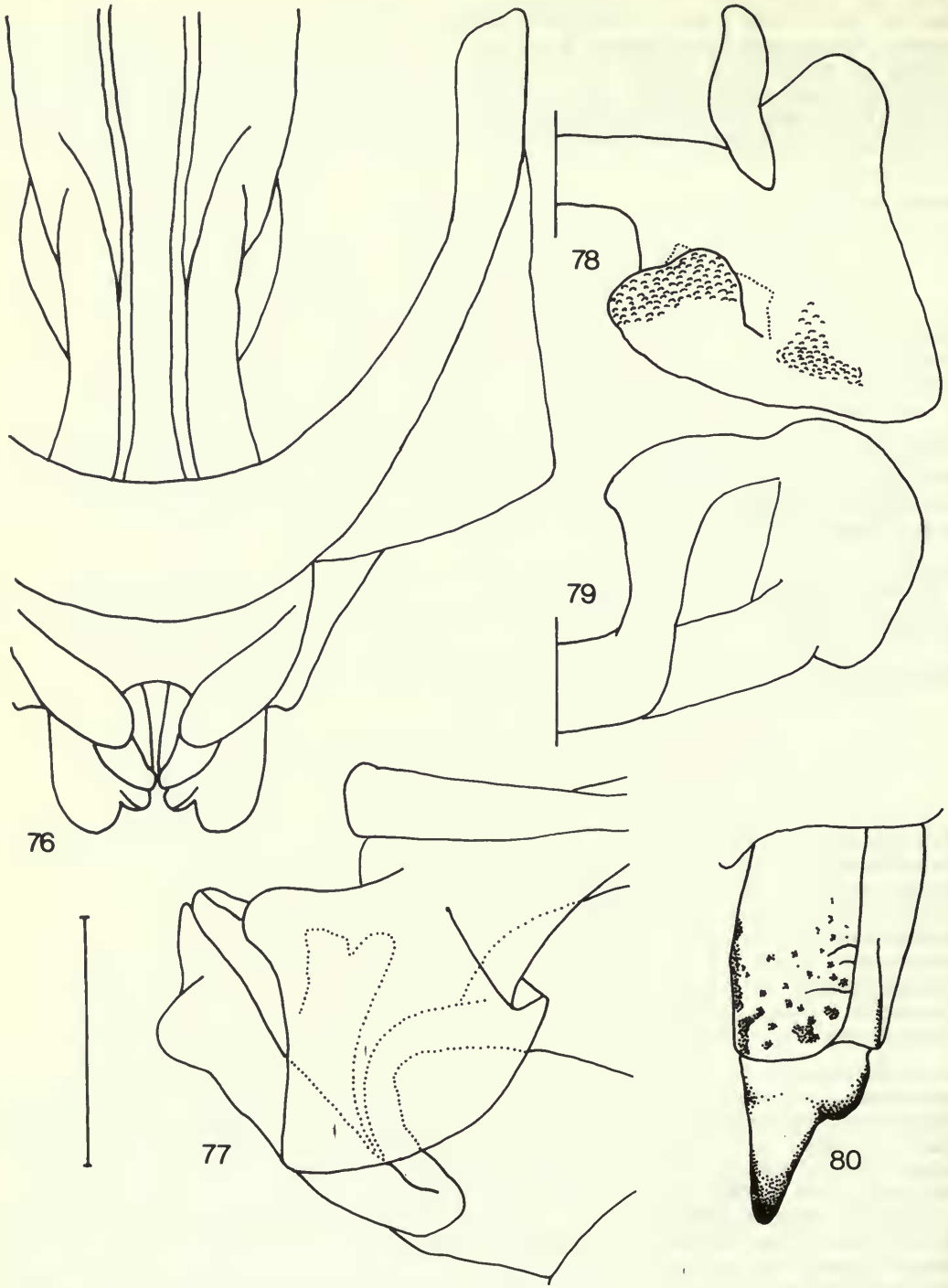
Gastrimargus wahlbergii (Stål, 1873)

(Figs 76–80, 111, 145)

Pachytylus (*Oedaleus*) *wahlbergii* Stål, 1873: 124. Holotype ♀, SOUTH AFRICA (NR, Stockholm) [examined].
Pachytylus wahlbergii Stål; I. Bolívar, 1881: 117 [probably misidentified].
Oedaleus (*Gastrimargus*) *wahlbergii* (Stål) Saussure, 1884: 113.
Oedaleus wahlbergii (Stål); I. Bolívar, 1889: 103.
Oedaleus marmoratus wahlbergi [sic] (Stål); Griffini, 1897: 6.
Gastrimargus wahlbergii (Stål) Kirby, 1910: 227.
Oedaleus wahlbergi [sic] (Stål) Bruner, 1910: 634.
Gastrimargus wahlbergi [sic] (Stål) Zacher, 1917: 164.
Pachytylus (*Oedaleus*) *wahlbergi* [sic] Stål; Sjöstedt, 1932; 20.

DIAGNOSIS. [Antennae lacking in males examined.] Fastigium of vertex convex. Pronotum with median carina high arcuate, sometimes intersected by posterior sulcus; dorsum with numerous pale globular warts, often forming rows; hind margin elongated, rounded acutangular (Fig. 145). Tegmen surpassing folded hind knees by one-fifth of hind femur length. Genitalia (Figs 76–79) with strongly protruding aedeagus and large bulbous subapical ventral process; outer lobe of lophi laterally elongated, forming a low, lozenge-shaped bump (Figs 78, 79). Ventral ovipositor valves with external lateral surface distinctly excavated (Fig. 80).

Coloration typical for genus. Pronotal ×-marking with posterior arms thicker than anterior arms; metazona with several indistinct pale striae extending outwards and backwards on each side of median carina. Tegmen as in *G. africanus*, with two transverse light bands two-sevenths and four-sevenths along from base. Hind wing with strong complete fascia (Fig. 145); basal area pale greenish yellow with some pale bluish tinting at the bases of main veins, more extensive in females. Hind femur externally with two indistinct oblique bands; internal and external upper and lower carinulae with regularly spaced black dots; internal surface in male with some dark shading in basal half, in female straw-coloured; ventral surface from lower carinula blue-grey. Hind tibia orange red, spines black-tipped.



Figs 76–80 *Gastrimargus wahlbergii*, genitalia. 76, phallic complex, dorsal view; 77, same, lateral view; 78, epiphallus, right half, dorsal view; 79, same, posterior view; 80, ovipositor, left half, ventral view.

MEASUREMENTS
Sample from Southern Africa, various localities.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	42·50	6·32	10·82	31·52	22·00	5·85	3·76	2·92
Range	41·7–43·3	6·3–6·6	10·3–11·3	31·0–32·1	21·9–22·1	5·6–6·1	3·6–3·9	2·8–3·0
S.D.	—	—	—	—	—	—	—	—
n	2	2	2	2	2	2	2	2
Females								
Mean	53·13	8·85	14·01	40·25	28·07	7·15	3·93	2·89
Range	49·1–57·1	8·2–9·6	11·3–15·6	35·6–44·3	24·5–31·8	5·7–8·1	3·5–4·3	2·8–3·0
S.D.	5·622	0·566	1·390	3·723	3·107	0·907	0·282	0·088
n	2	5	5	4	5	5	5	4

AFFINITIES. *G. wahlbergii* is allied to *G. angolensis* below on the basis of the genitalia, the rugosity of the pronotum, and the blue tint of the ventral surface of the hind femur.

MATERIAL EXAMINED

Gastrimargus wahlbergii Stål, holotype ♀, **South Africa**: Caffraria (NR, Stockholm).

South Africa: 1 ♂, 1 ♀, Natal, Ndumu, 11–15.xii.1960 (*Van Son*) (TM, Pretoria); 1 ♂, Natal, Lebombo Mts, 11–14.xii.1961 (*Vári & Steenstra*) (TM, Pretoria); 1 ♀, Transvaal, Rosslyn, 17.ii.1957 (*Vári*) (TM, Pretoria); 1 ♀, Transvaal (MHN, Geneva). **Lesotho**: 1 ♀, Mamathes (*Jacot Guillarmod*) (ANS, Philadelphia).

DISTRIBUTION (Fig. 111, and Biogeography section, p. 308). *G. wahlbergii* is known from the eastern half of South Africa, and Lesotho. The record from Angola (Bolívar, 1881) is probably erroneous and that from the Comoro Is. (Bruner, 1910; Chopard, 1958) is certainly so.

BIOLOGY. Unknown. The record of this species from tobacco (Ballard, 1914; Zacher, 1917) is unconfirmed, and in view of the rarity of the species should be regarded with suspicion.

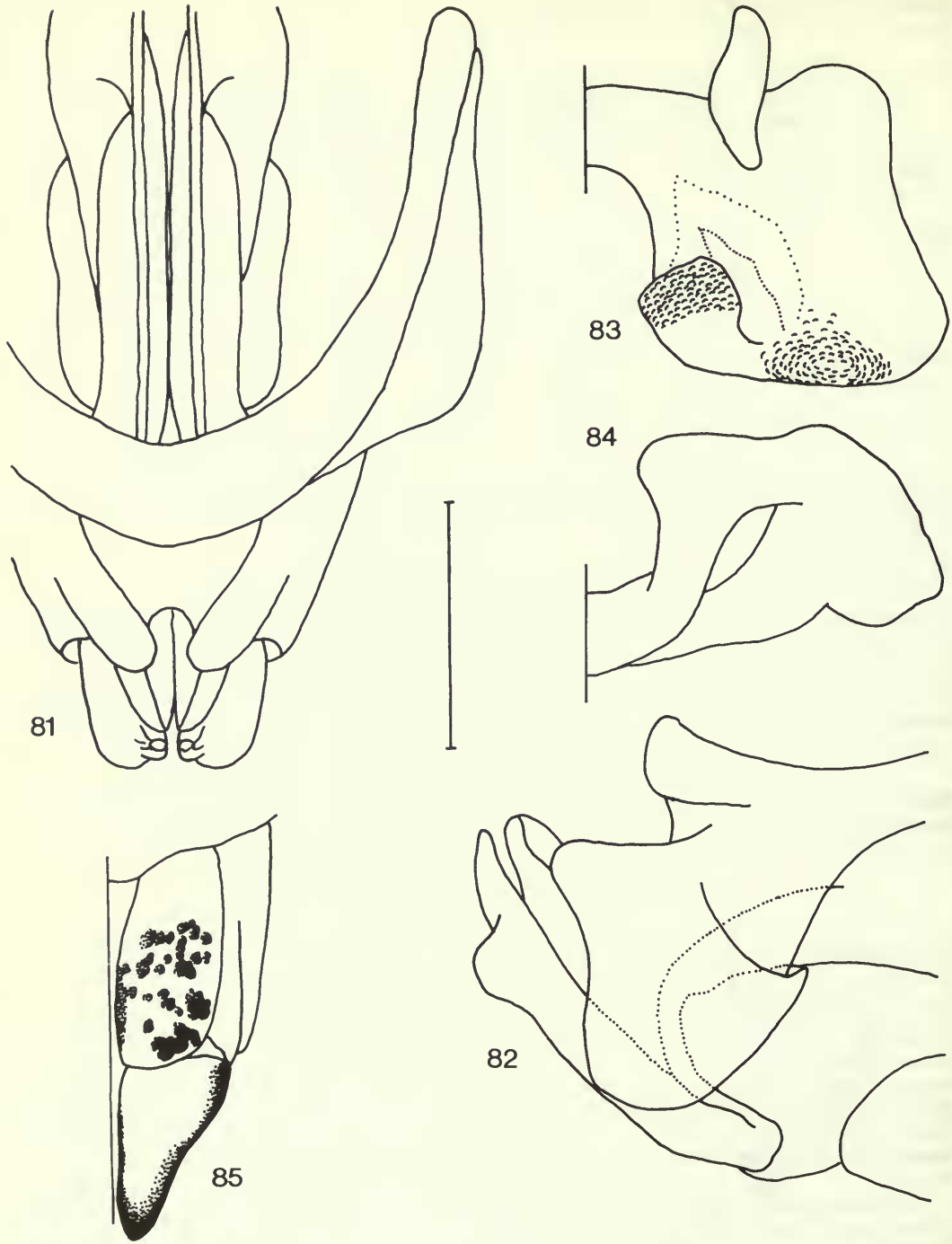
Gastrimargus angolensis Sjöstedt, 1928 **sp. rev.**

(Figs 81–85, 111, 146)

Gastrimargus angolensis Sjöstedt, 1928: 30. Holotype ♀, ANGOLA (MNHU, Berlin) [examined].
Gastrimargus corallipes Sjöstedt, 1928: 31. Holotype ♀, ZAIRE (MRAC, Tervuren) [examined]. **Syn. n.**
[*Gastrimargus vitripennis* (Saussure) Dirsh, 1966: 429. Misidentification.]

DIAGNOSIS. Antennae short, four-fifths as long as head and pronotum together in male. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; dorsum with some scattered globular warts; hind margin acutangular. Tegmen surpassing folded hind knees by one-fifth of hind femur length. Genitalia (Figs 81–85) similar to *G. wahlbergii*; aedeagus strongly protruding, with large bulbous subapical ventral process; outer lobe of lophi laterally elongated, forming a low lozenge-shaped bump (Figs 83–84). Ventral ovipositor valves (Fig. 85) with external lateral surface shallowly and smoothly incurved.

Coloration typical for genus, similar to *G. wahlbergii*. Pronotal ×-marking green or rarely light brown; posterior arms much thicker than anterior arms; metazona with indistinct pale striae as in *G. wahlbergii*. Tegmen with pale cross-bands about one-third and one-half along from base. Hind wing with fascia complete but very faint (Fig. 146); basal area of wing pale greenish yellow; apical half of wing faintly infumate with darkened veins, paler in female. Hind femur unbanded or occasionally with traces of banding on external surface; external dorsal and ventral carinulae and internal dorsal carinula each with a row of irregular black dots; internal surface blackish brown in medial area of male, female blackish brown in basal half only or not at all; internal ventral surface blue-black. Hind tibia dull light red.



Figs 81–85 *Gastrimargus angolensis*, genitalia. 81, phallic complex, dorsal view; 82, same, posterior portion, lateral view; 83, epiphallus, right half, dorsal view; 84, same, posterior view; 85, ovipositor, left half, ventral view.

MEASUREMENTS
Sample from Central Africa, various localities.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	34·62	5·74	9·20	25·03	17·23	4·67	3·69	2·72
Range	32·0–35·9	5·3–6·0	8·3–9·8	23·1–26·3	16·2–18·0	4·30–5·0	3·6–3·9	2·6–2·9
S.D.	1·140	0·226	0·344	1·000	0·496	0·155	0·200	0·081
n	14	14	14	14	14	14	14	14
Females								
Mean	50·03	8·87	13·01	36·10	24·50	6·55	3·74	2·80
Range	47·6–53·3	8·7–9·5	12·2–14·0	34·2–39·5	22·7–26·0	6·3–6·9	3·6–4·0	2·6–3·0
S.D.	1·287	0·211	0·544	1·220	0·719	0·172	0·102	0·139
n	17	18	20	17	20	20	20	17

AFFINITIES. As stated above (p. 293), *G. angolensis* is closely allied to *G. wahlbergii.*

MATERIAL EXAMINED

Gastrimargus angolensis Sjöstedt, holotype ♀, **Angola**: Huila–Humpata (*Nonfried*) (MNHU, Berlin). *Gastrimargus corallipes* Sjöstedt, holotype ♀, Zaire: Kwango, Atene (*Charlier*) (MRAC, Tervuren).

Angola: 7 ♀, Malange distr., Gauca, 32 km E. of Rio Quanza, 1100 m, 7.i.1931 (*Boulton*) (ANS, Philadelphia); 1 ♂, 2 ♀, same data (BMNH); 3 ♂, 5 ♀, same data, 4.i.1931 (ANS, Philadelphia); 3 ♂, same data, 8.i.1931 (ANS, Philadelphia); 4 ♂, 2 ♀, same data, 6.i.1931 (ANS, Philadelphia); 1 ♂, same data (BMNH); 2 ♂, 3 ♀, Chitau, Bihé distr., 1470 m, 17.i.1931 (*Boulton*) (ANS, Philadelphia). **Zambia**: 1 ♀, Luano valley, i.1928 (*Burr*).

DISTRIBUTION (Fig. 111, and Biogeography section, p. 312). Angola, Zaire, Zambia.

DISCUSSION. This species was synonymised with *G. vitripennis* by Dirsh (1966) without any examination of the holotype. The banded hind wing and the blue-black ventral surface of the hind femur preclude this, however. Sjöstedt (1928) described *G. angolensis* and *G. corallipes*, both from unique female specimens, on succeeding pages of his monograph. They were artificially separated by trivial colour characters in his key, but the distinctions are not longer tenable in the light of more recently discovered material.

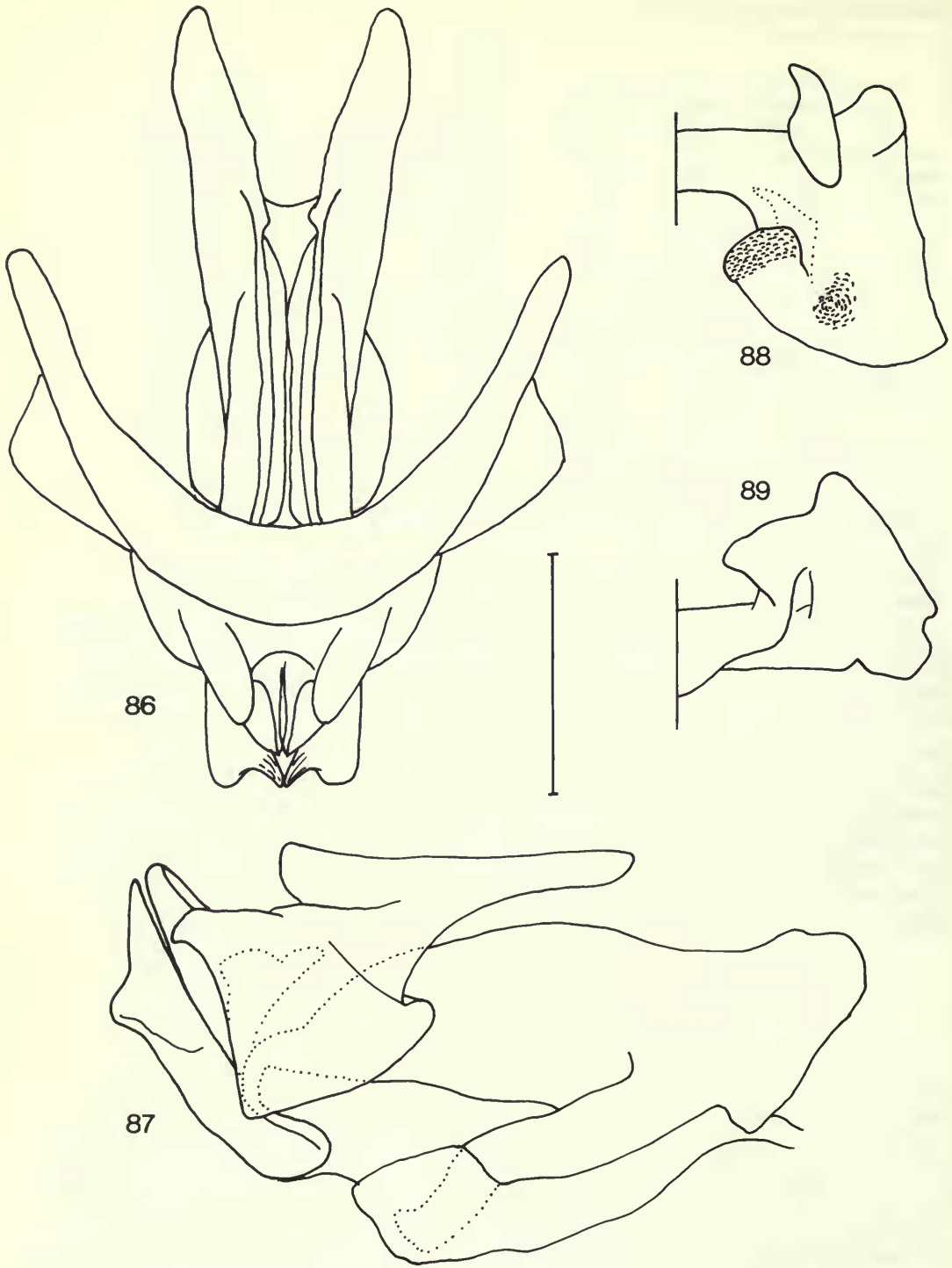
Gastrimargus mirabilis Uvarov, 1923

(Figs 86–89, 111, 147)

Gastrimargus mirabilis Uvarov, 1923: 675. Holotype ♀, UGANDA (BMNH, London) [examined].

DIAGNOSIS. Fastigium of vertex convex. Pronotum with dorsal surface scattered with globular warts; median carina high arcuate, forming a blade-like crest, not intersected by posterior sulcus; hind margin very elongated and sharply acutangular, forming an angle of less than 45°. Tegmen surpassing folded hind knees by about one-third of hind femur length. Hind femur long and thin, length/depth ratio 5·16–5·71 ♂, 4·89–5·72 ♀. Genitalia typical for genus, with aedeagus strongly protruding and with prominent subapical ventral process; epiphallus with small protruding outer lobe of lophi.

Coloration normal for genus. Pronotal ×-marking with lateral angles very obtuse, posterior arms sometimes obliterated; sides of raised pronotal crest always brown. Tegmen dark, rarely with faint transverse bands. Hind wing fascia complete (Fig. 147), fading anteriorly in female; basal area of wing pale yellow. Hind femur unmarked except for rows of irregularly spaced dots on inner and outer dorsal and ventral carinulae. Hind tibia dull reddish in male, brown or reddish brown in female.



Figs 86–89 *Gastrimargus mirabilis*, genitalia. 86, phallic complex, dorsal view; 87, same, lateral view; 88, epiphallus, right half, dorsal view; 89, same, posterior view.

MEASUREMENTS
Sample from Central Africa, various localities.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	32·90	4·44	9·93	24·35	15·67	2·85	5·51	2·46
Range	31·3–34·4	4·2–4·6	9·3–10·3	23·3–25·8	15·2–16·0	2·7–3·1	5·2–5·7	2·3–2·6
S.D.	1·154	0·160	0·372	0·991	0·382	0·180	0·302	0·105
n	5	5	5	5	3	3	3	5
Females								
Mean	52·93	7·87	15·08	38·31	25·69	4·87	5·29	2·51
Range	47·4–59·6	7·1–8·9	14·0–15·7	34·0–44·0	23·2–30·6	4·3–5·9	4·9–5·7	2·4–2·7
S.D.	3·947	0·679	0·604	3·187	2·370	0·514	0·259	0·100
n	6	7	6	7	7	7	7	5

AFFINITIES. *G. mirabilis* is not closely allied to any other member of the genus. However, it has affinities with *G. wahlbergii* and its allies in the large aedeagus with pronounced subapical ventral process, and the warty integument of the pronotum with its raised carina.

MATERIAL EXAMINED

Gastrimargus mirabilis, holotype ♀, **Uganda**: Entebbe, 26–29.vi.1912 (*Gowdey*) (BMNH).

Uganda: 1 ♂, 1 ♀, Entebbe, 12.x.1914 (*Gowdey*) (paratypes of *G. mirabilis*); 1 ♂, Buddu, Kakuto, seasonal swamp, 12.i.1936 (*Johnston*). **Kenya**: 1 ♀, Kakamega Forest, 0°15′N, 34°52′E, 1530 m, 18–22.i.1972 (*Huggins*). **Zaire**: 1 ♀, Leopoldville, 11.x.1957 (*Jobels*) (MRAC, Tervuren); 1 ♂, 1 ♀, Luluabourg (MHN, Geneva); 1 nymph, Upemba National Park, Kilwezi, 750 m, 2–21.viii.1948 (*de Witte*) (IRSNB, Brussels); 4 ♂, 1 ♀, Upemba National Park, R. Kafwi, tributary of R. Lufwa, 1780 m, 15.iii.1948 (*de Witte*) (IRSNB, Brussels); 5 ♂, 1 ♀, U.N.P., R. Kenia, tributary of R. Lusinga, 1585 m, 5.v.1949 (*de Witte*) (IRSNB, Brussels); 1 ♂ U.N.P., Mukana, 1810 m, 22–23.iv.1949 (*de Witte*) (IRSNB, Brussels); 1 ♀, same data, 18.iii.1948 (IRSNB, Brussels); 1 ♂, U.N.P., Mukana, Lusinga, 1810 m. 19.iv.1949 (*de Witte*) (IRSNB, Brussels); 1 ♀, same data, 2.viii.1947 (IRSNB, Brussels); 11 ♂, U.N.P., Lusinga, 1760 m, 22.iv.–4.v.1949 (*de Witte*) (IRSNB, Brussels); 7 ♀, U.N.P., Mbuye-Bala, 1750 m, 24–31.vi.1948 (*de Witte*) (IRSNB, Brussels); 1 ♂, 2 ♀, U.N.P., Kamitungulu, 1700 m, 14.vii.1947 (*de Witte*) (IRSNB, Brussels); 1 ♂, U.N.P., Kankunda, 1300 m, 14–24.vi.1927 (*de Witte*) (IRSNB, Brussels); 5 ♂, 2 ♀, U.N.P., Kabwekanono, 1815 m, 25.iv.–6.v.1947 (*de Witte*) (IRSNB, Brussels); 32 ♂, 20 ♀, U.N.P., Kabwoe sur Muye, 1320 m, 20.iv.–25.v.1948 (*de Witte*) (IRSNB, Brussels); 1 ♂, 4 ♀, U.N.P., R. Mubale, 1480 m, 1–20.v.1947 (*de Witte*) (IRSNB, Brussels); 3 ♂, U.N.P., Mundi, Lupiala, tributary of R. Lufira, 28.v.–5.vii.1948 (*de Witte*) (IRSNB, Brussels). **Zambia**: 1 ♀, Broken Hill, ii.1931 (ANS, Philadelphia). **Angola**: 1 ♂, 3 nymphs, Luchase distr., R. Quango, 1500 m, 16.x.1927 (*Burr*); 2 nymphs, Moxico distr., valley of R. Mu-Simoj, 25.x.1927 (*Burr*); 1 nymph, Moxico distr., R. Lungue Bungu, 3.x.1927 (*Burr*); 2 ♂, 3 ♀, Palavange, 2.xi.1930 (*Green*) (ANS, Philadelphia).

DISTRIBUTION (Fig. 111, and Biogeography section, p. 312). Uganda, Zaire, Zambia, Angola.

Gastrimargus insolens sp. n.

(Figs 111, 148)

DIAGNOSIS (based on unique female; male unknown). Antennae about two-thirds as long as combined length of head and pronotum. Fastigium of vertex convex. Pronotum with median carina arcuate, not intersected by posterior sulcus; hind margin acutangular. Tegmen surpassing hind knees by one-seventh of hind femur length. Ventral ovipositor valves short, less than one and a quarter times as long as perpendicular basal width.

Coloration generally greenish brown. Pronotal ×-marking thin. Tegmina green with large irregular brown blotches separated by green cross-banding in basal two-thirds, becoming clear with brown speckles in apical third (Fig. 148). Hind wing fascia (Fig. 148) indistinct, with darkened cells diffused along costal margin from fascia towards wing tip; basal area of wing pale yellow. Hind femur externally green with bluish tinge in medial area, unmarked; internal medial area blue-black, becoming blue-grey apically; ventral surface brownish red; interior ventral carina orange-red. Hind knee green. Hind tibia orange.

MEASUREMENTS

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Holotype ♀	39·7	6·7	9·8	28·5	21·2	4·9	4·3	2·9

AFFINITIES. *G. insolens* has similar pronotal markings to *G. verticalis*, but is otherwise differentiated from that species by its short ovipositor, the coloration of the hind femur, and the form of the reduced wing fascia. Without the male it is impossible accurately to assess the relationships of the species. However in the context of a revision of all the known species of the genus, it is clear that the unique female belongs to a previously undescribed species of *Gastrimargus*.

MATERIAL EXAMINED

Holotype ♀, **Angola**: Sá da Bandeira, Huila distr., 12–14.iv.1971 (*Brown*) (DATS, Pretoria).

DISTRIBUTION (Fig. 111, and Biogeography section, p. 312). Sá da Bandeira, SW. Angola.

Gastrimargus acutangulus (Stål, 1873)

(Figs 90—97, 111, 149)

Pachytylus (*Oedaleus*) *acutangulus* Stål, 1873: 125.

This species is here presented as two subspecies under which the specific synonymy is separately listed.

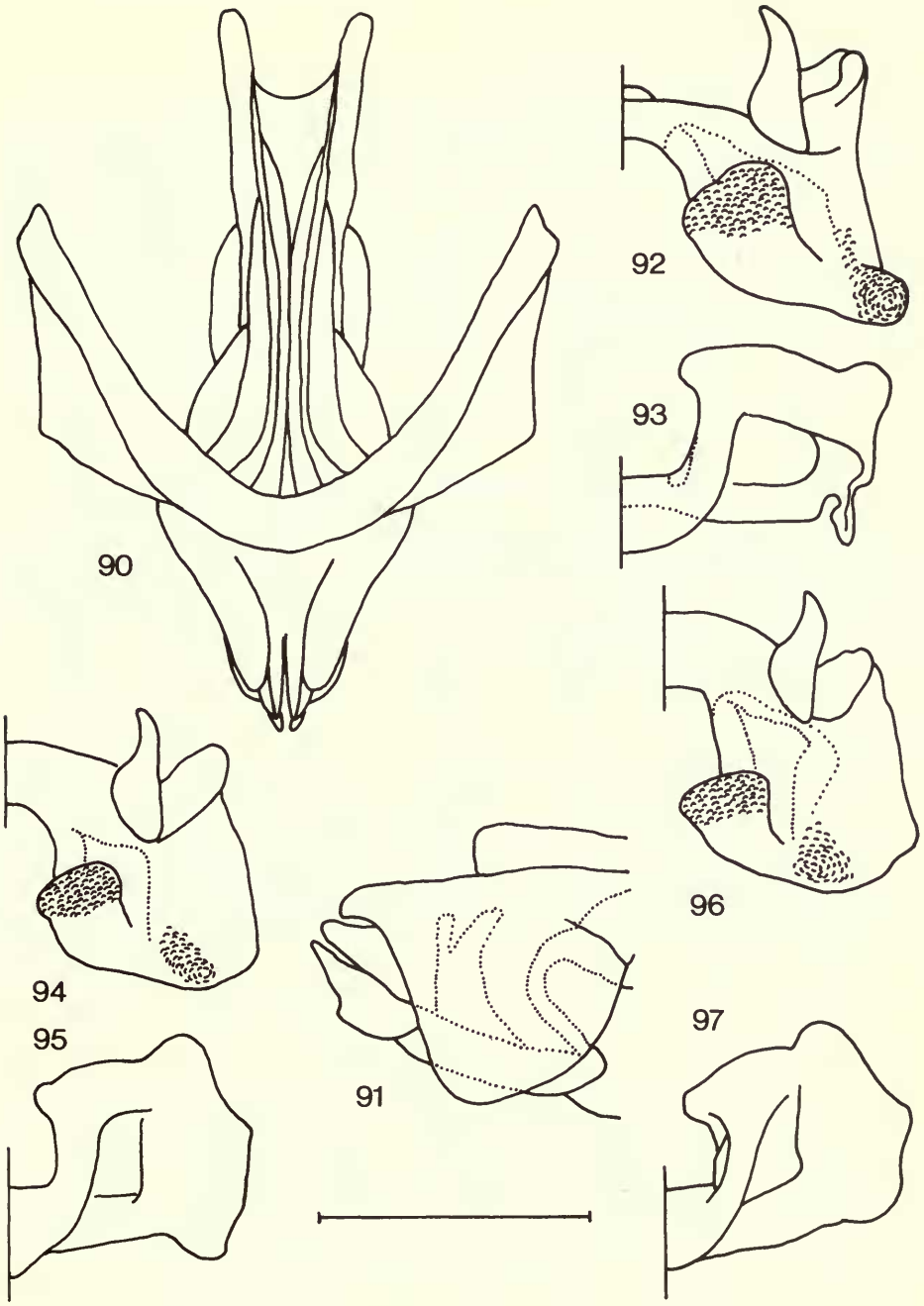
DIAGNOSIS. Fastigium of vertex convex with distinct medial carinula. Pronotum with median carina high arcuate, almost blade-like, not intersected by posterior sulcus; dorsum scattered with small pale globular warts; hind margin elongate acutangular. Tegmen exceeding hind knees by about one-quarter to one-third of hind femur length. Intercalary vein shiny, not serrated. Genitalia (Figs 90–97) with long cingular rami, aedeagus weakly protruding with small subapical ventral process; epiphallus with lophi varying according to locality (Figs 92–97).

COLORATION. Green morphs with a more bluish tinge than in other species. Pronotal ×-marking with anterior arms thinner than posterior arms. Tegmen with three to five pale cross-bands of variable extent. Hind wing with fascia (Fig. 149) complete and very broad; basal area of wing bright blue. Hind femur externally with three indistinct oblique cross-bands in medial area; internal surface with large dark brown patch in basal half, overlaid in places by opaque pale bluish sheen; internal ventral surface red.

AFFINITIES. There does not appear to be any close relationship between this species and other members of the genus.

DISTRIBUTION (Fig. 111, and Biogeography section, p. 308). *G. acutangulus* occurs in the highlands of Kenya (subspecies *flavipes*) and the eastern part of South Africa (subspecies *acutangulus*). In addition there is a population on the Nyika plateau of Malawi and Zambia which has genitalia intermediate between the two subspecies and coloration typical of *G. a. acutangulus*. The records of *G. acutangulus* from Guinea (Saussure, 1888: 39; Dirsh, 1966: 426), Ivory Coast (Dirsh, 1966: 426) Angola (Bolívar, 1889: 103; Dirsh, 1966: 426) and Zanzibar (Saussure, 1884: 114; Dirsh, 1966: 426; Johnsen & Forchammer, 1975: 51) are erroneous. Sjöstedt (1928: 51) incorrectly refers to Saussure's misidentified specimen from Zanzibar as a type.

DISCUSSION. The type of *G. dohrnianus* Saussure has proved impossible to locate. However, the synonymy established by Sjöstedt (1928) is not in doubt. Dirsh (1966: 426) synonymised *G. acutangulus flavipes* on the grounds that it differed from the nominate subspecies only by the yellow colour of the hind tibiae and that this was not a consistent character. Both these suppositions are incorrect. The key to subspecies given here employs pronotal colour pattern as well as



Figs 90–97 *Gastrimargus acutangulus*, genitalia. 90, phallic complex, dorsal view, *G. a. acutangulus*, South Africa; 91, same, posterior portion, lateral view; 92, epiphallus, right half, dorsal view, *G. a. acutangulus*, South Africa; 93, same, posterior view; 94, same, dorsal view, Malawi; 95, same, posterior view; 96, same, dorsal view, *G.a flavipes*, Kenya; 97, same, posterior view.

the colour of the hind tibiae as reliable characters to distinguish the disjunct northern and southern populations. Dirsh evidently overlooked the geographical basis of the observed variation in this species.

Key to subspecies of *Gastrimargus acutangulus*

1 Pronotum with posterior arms of ×-marking forming an angle between themselves of about 70° and recurving posteriorly to meet pale marking on pronotal shoulders without forming a distinct angle before continuing round hind margin; enclosed dark triangles flanking median carina in metazona with rounded outer angles (Fig. 149). Outer lobes of epiphallic lophi strongly divergent (Figs 92, 93). Hind tibiae bright orange, at least on inner surface (South Africa, Malawi, Zambia) . . . . . ***G. acutangulus acutangulus*** (Stål) (p. 300)

– Pronotum with posterior arms of ×-marking forming an angle between themselves of about 80–90°, and meeting pale markings on pronotal shoulders at a distinct obtuse angle before continuing round hind margin; enclosed dark triangles flanking median carina in metazona with sharply obtuse outer angles. Outer lobes of epiphallic lophi weakly convergent or weakly divergent (Figs 94–97). Hind tibiae straw-coloured to pale orange-yellow (Kenya)

G. acutangulus flavipes Johnston (p. 301)

Gastrimargus acutangulus acutangulus (Stål, 1873)

Pachytylus (*Oedaleus*) *acutangulus* Stål, 1873: 125. Holotype ♀, SOUTH AFRICA (NR, Stockholm) [examined].
Oedaleus (*Gastrimargus*) *acutangulus* (Stål) Saussure, 1884: 114.
Oedaleus (*Gastrimargus*) *dohrnianus* Saussure, 1888: 166. Holotype ♀, SOUTH AFRICA: Transvaal (lost?). [Synonymised by Sjöstedt, 1928: 33.]
Oedalus [sic] *acutangulus* (Stål); Distant, 1892: 257.
Gastrimargus acutangulus (Stål) Kirby, 1902: 72.

MEASUREMENTS

Sample from South Africa.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	37·68	5·45	9·11	28·72	20·06	4·97	4·04	3·16
Range	35·9–39·1	5·2–5·7	8·3–9·6	27·4–29·9	18·5–21·0	4·7–5·1	3·9–4·2	3·0–3·3
S.D.	1·070	0·136	0·492	0·825	0·780	0·140	0·090	0·111
n	10	12	11	11	12	12	12	10
Females								
Mean	47·53	7·26	12·25	36·10	25·93	6·69	3·90	2·94
Range	45·3–50·7	6·2–7·6	11·6–13·1	34·6–39·7	23·3–27·3	5·9–7·7	3·5–4·3	2·8–3·4
S.D.	1·980	0·253	0·499	1·604	1·176	0·560	0·259	0·164
n	5	11	11	10	10	10	10	10

MATERIAL EXAMINED

Pachytylus acutangulus Stål, holotype ♀, **South Africa**: 'Caffraria' (*Wahlberg*) (NR, Stockholm).

South Africa: 2 ♂, 2 ♀, Orange Free State, Orange River Colony (*B-Hamilton*); 1 ♀, no data (Distant); 2 ♂, 2 ♀, Transvaal, Pretoria (*Distant*); 1 ♀, Tvl, Bloksberg, Johannesburg, Observatory Ridge, iv. 1938 (*Burtt*); 1 ♂, Tvl, Johannesburg, 17.ix.1950 (*Balinsky*); 1 ♀, same data, 10.ix.1950; 1 ♀, Tvl, Klipriviersburg, 24 km S. of Johannesburg, 3.v.1938 (*Burtt*); 1 ♂, Tvl, Witwatersburg, NE. of Krugersdorp, 2.v.1938 (*Burtt*); 1 ♂, Natal, Bergville dist., Mont-aux-sources, 1950 m, rough scrub, 5.ix.1954 (*Balfour-Browne*); 3 ♂, Natal, Lydenburg

distr., 1896 (*Krantz*) (Ans, Philadelphia); 1 ♂, 1 ♀, Natal, Amanzimtoti, 19.iv.1935 (*W.P.*) (ANS, Philadelphia); 1 ♀, Natal, Estcourt (*Havil*) [also labelled, probably incorrectly: 'Cap, M. Peringuey'] (MHN, Geneva); 1 ♂, Natal, Ladysmith, Spion Kop, lower slopes, N. side, 25.viii.1905 (*Dixey*) (UM, Oxford). **Malawi**: 1 ♂, Nyika Plateau, 9.xi.1970. **Zambia**: 1 ♀, Nyika Plateau, 10°35'S 33°45'E, 2190 m, viii.1962 (*Newman*).

Gastrimargus acutangulus flavipes Johnston, 1937 **subsp. rev.**

Gastrimargus acutangulus flavipes Johnston, 1937: 220. Holotype ♂, KENYA (BMNH) [examined]. [Incorrectly synonymised by Dirsh, 1966: 426.]

MEASUREMENTS
Sample from Kenya.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	34·66	5·16	8·30	26·15	17·82	4·46	3·99	3·19
Range	31·2–35·9	4·6–5·6	7·6–9·4	23·5–27·4	15·9–18·9	4·1–4·8	3·9–4·2	2·9–3·4
S.D.	1·805	0·334	0·643	1·417	1·236	0·245	0·109	0·219
n	6	7	6	6	7	7	7	5
Females								
Mean	42·88	6·54	10·74	31·99	22·80	5·94	3·85	3·00
Range	39·0–45·2	6·0–7·1	10·0–11·6	28·8–33·6	21·3–24·1	5·4–6·8	3·5–4·0	2·8–3·2
S.D.	2·163	0·347	0·651	1·766	1·111	0·474	0·139	0·135
n	6	8	8	6	8	8	8	6

MATERIAL EXAMINED

Gastrimargus acutangulus flavipes Johnston, holotype ♀, **Kenya**: Mt Kenya, grassy places in forest, 2600–2940 m, v.1935 (*Hancock*) (BMNH).

Kenya: 4 ♂, 4 ♀, 1 nymph, Mt Kenya, grassy places in forest, 2600–2940 m, v.1935 (*Hancock*) (paratypes of *G. acutangulus flavipes*); 2 ♂, 2 ♀, Mau, 1935 (*Buxton*) (1 ♂, 1 ♀, paratypes of *G. acutangulus flavipes*); 2 ♀, Kinangop, vi.1930 (*Turner*) (1 ♀, paratype of *G. acutangulus flavipes*); 1 ♂, Lamu and Malindi, 1974–75 (*Pfau*) (COPR, London).

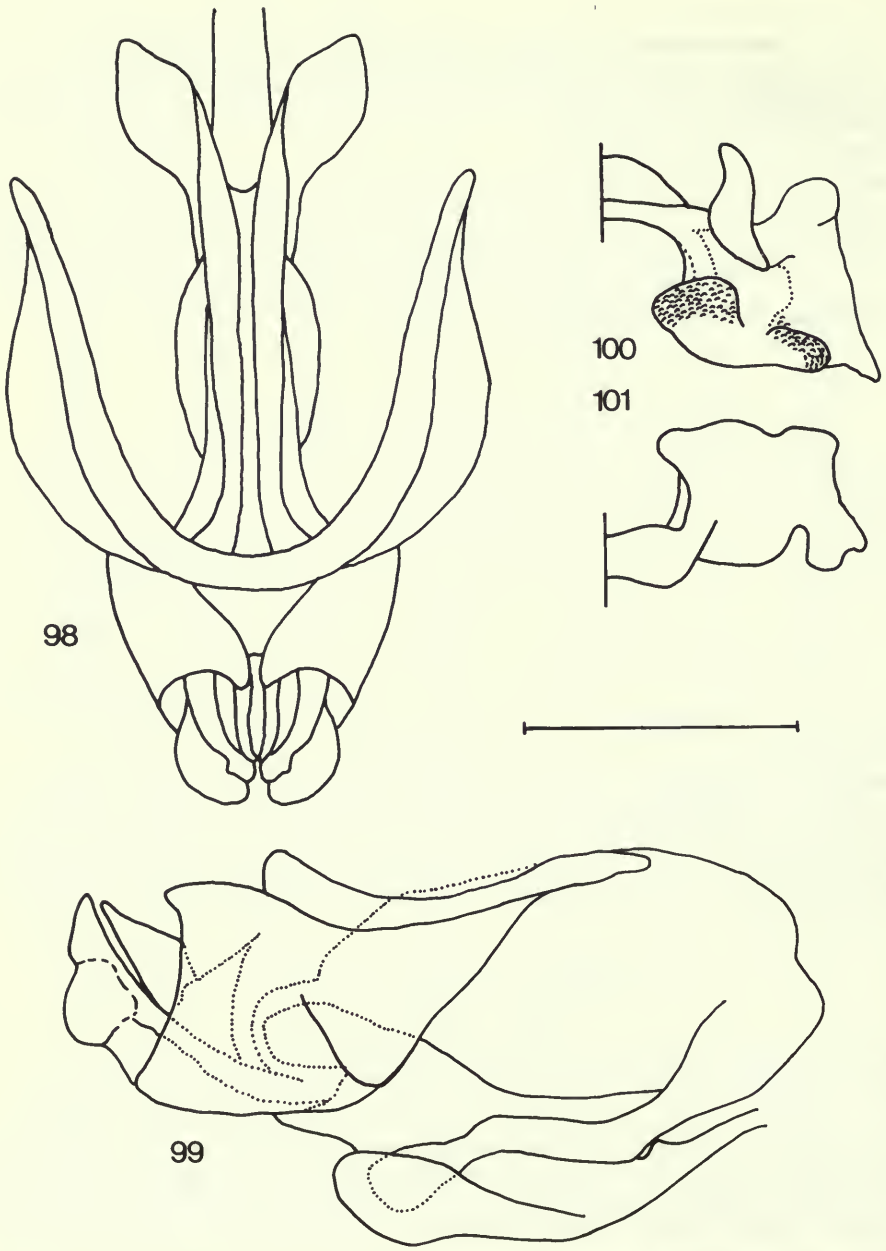
Gastrimargus ochraceus Sjöstedt, 1928

(Figs 98–101, 111, 150)

Gastrimargus ochraceus Sjöstedt, 1928: 47. Holotype ♀, GHANA: (BMNH) [examined].
Gastrimargus ochraceus Sjöstedt; Gillon, 1974: 158. [Description of previously unknown male.]

DIAGNOSIS. Fastigium of vertex convex. Pronotum with median carina low arcuate, straight in profile, not intersected by posterior sulcus; hind margin rectangular in male, obtusangular in female. Tegmen surpassing folded hind knees by one-seventh of hind femur length in male, failing to reach hind knees by one-fifth of hind femur length in female. Genitalia (Figs 98–101) with aedeagus strongly projecting, and with very large bulbous subapical ventral process; aedeagal apodemes short, rounded in profile, not elongated anteriorly.

Coloration generally mottled brown. Pronotal ×-marking with anterior arms distinct, thin, curved; posterior arms usually obsolete, occasionally faintly visible. Tegmen brown with variable pale cross-banding in basal half; apical half pale, opaque, with large rounded brown patches, clearing towards apex. Hind wing fascia (Fig. 150) variable, narrowly interrupted between *Cu*2 and 2*A*, or restricted to posterior half of wing beyond 3*A*. External surface of hind femur with 2–3 oblique cross-bands in medial area; upper and lower marginal areas sometimes with an irregular row of small dark dots; internal surface dark brown; ventral surface light reddish brown in male, red in basal half in female. Hind tibiae brown.



Figs 98–101 *Gastrimargus ochraceus*, genitalia. 98, phallic complex, dorsal view; 99, same, lateral view; 100, epiphallus, right half, dorsal view; 101, same, posterior view.

MEASUREMENTS
Sample from West and Central Africa, various localities.

	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Males								
Mean	25·33	3·88	5·02	18·02	13·75	2·70	5·10	3·60
Range	23·7–27·7	3·4–4·3	4·4–5·5	17·2–19·6	12·2–15·4	2·3–2·9	4·8–5·3	3·4–3·9
S.D.	2·062	0·404	0·530	1·371	1·602	0·304	0·272	0·202
n	3	3	3	3	3	3	3	3
Females								
Mean	30·97	6·83	8·00	19·62	19·48	4·12	4·73	2·47
Range	28·6–33·6	6·3–7·7	7·0–9·4	17·9–21·6	17·7–22·0	3·8–4·7	4·7–4·8	2·3–2·6
S.D.	2·490	0·718	1·201	1·864	2·231	0·465	0·065	0·136
n	3	3	3	3	3	3	3	3

AFFINITIES. *G. ochraceus* has no apparent close affinities with other members of the genus. The unusual male genitalia (Figs 98–101), and the distinctive pronotal pattern suggest that the species is not nearly related to other species.

MATERIAL EXAMINED
Gastrimargus ochraceus Sjöstedt, holotype ♀, **Ghana**: N. Territories, Sankwalla, 4–7.xi.1915 (*Simpson*) (BMNH).

Ivory Coast: 1 ♂, 1 ♀, Lamto, Toumodi, 18.xi.1964 (*Gillon*) (ORSTOM, Abidjan); 1 ♀, same data (BMNH); 1 ♂, same data, 22.iii.1965 (BMNH); 1 nymph, Lamto, 1.x.1963 (*Gillon*) (ORSTOM, Abidjan). **Zaire**: 1 ♂, Lumu, 7–15.iv.1975 (*S.B.Z*) (MZDS, Florence).

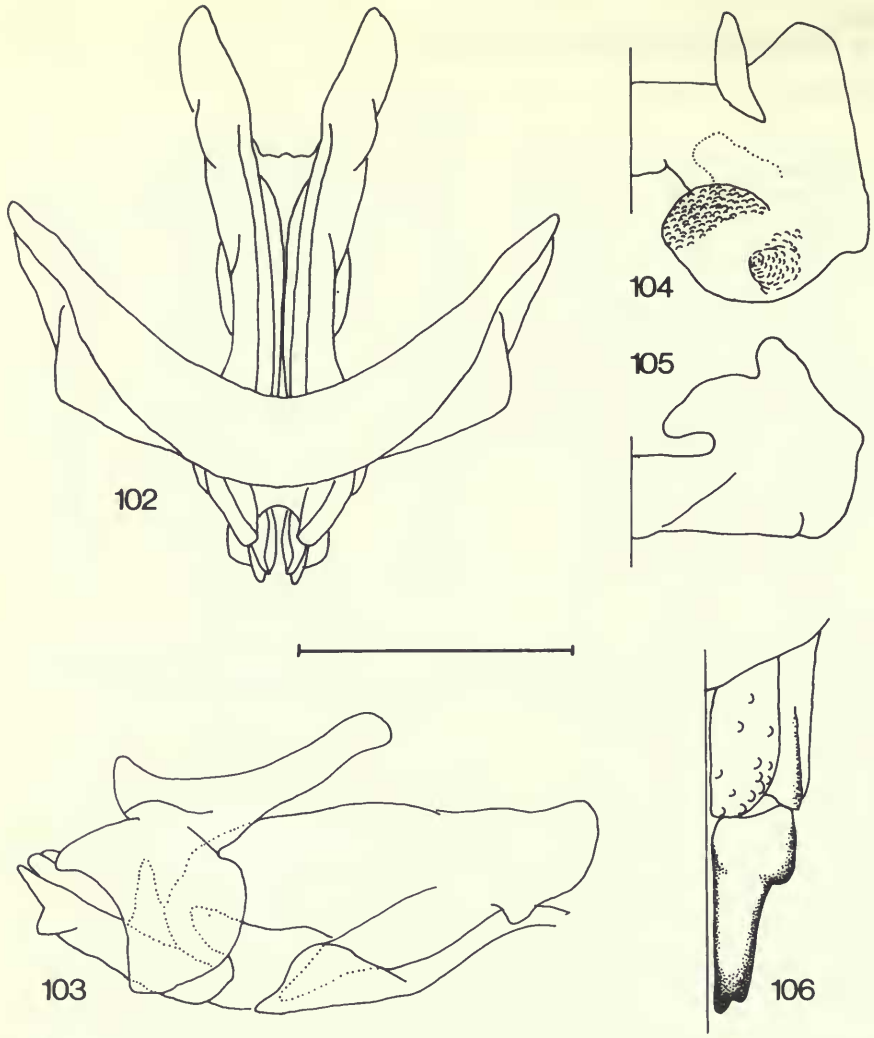
DISTRIBUTION (Fig. 111, and Biogeography section, p. 313). Ghana, Ivory Coast, Zaire, Habitat information for Ivory Coast is given by Gillon (1974).

Gastrimargus willemsei sp. n.

(Figs 102–106, 120, 151)

DIAGNOSIS. Antennae short, four-fifths as long as head and pronotum together. Fastigium of vertex concave. Pronotum with median carina low arcuate, flat or concave in profile, not intersected by posterior sulcus in male, sometimes intersected in female; hind margin blunt acutangular. Tegmen surpassing folded hind knees by one-third of hind femur length in male, barely surpassing knees in female. Genitalia (Figs 102–106) with thick cingular arch and weakly protruding aedeagus; epiphallic lophi with relatively large bulbous inner lobes and strongly protruding convergent outer lobes. Ventral ovipositor valves elongated and distinctly bifurcated at apex (Fig. 106).

Coloration generally dark brown. Pronotal ×-marking sometimes almost obsolete. Tegmen with 2–3 variable cross-bands, often reduced, sometimes obsolete. Hind wing fascia (Fig. 151) complete, approaching wing base along costal margin; apical half of wing densely infumate, sometimes less so in female; basal area of wing pale yellow to colourless. Hind femur externally with 3 oblique transverse dark bands; internal surface with large dark brown patch in basal half; internal and external ventral surfaces dark brown to blue-black. Hind tibia dark red.



Figs 102–106 *Gastrimargus willemsei*, genitalia. 102, phallic complex, dorsal view; 103, same, lateral view; 104, epiphallus, right half, dorsal view; 105, same, posterior view; 106, ovipositor, left half, ventral view.

MEASUREMENTS
Sample from New Guinea.

	Males							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	30·18	4·56	6·64	22·17	15·58	3·85	4·05	3·43
Range	27·2–32·7	4·2–4·7	6·4–7·1	19·6–24·3	13·7–16·6	3·7–4·2	3·7–4·2	3·0–4·0
S.D.	2·020	0·148	0·216	1·711	0·968	0·160	0·187	0·356
n	8	8	6	8	8	8	8	6

MEASUREMENTS—(*cont.*)

	Females							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	30·46	5·86	8·06	20·71	17·81	4·52	3·95	2·57
Range	28·4–33·7	5·4–6·2	7·4–8·6	19·5–22·1	17·0–19·2	3·9–4·9	3·7–4·4	2·3–3·0
S.D.	1·657	0·290	0·439	1·016	0·867	0·265	0·218	0·214
n	9	9	8	9	9	9	9	8

AFFINITIES. *G. willemsei* appears only distantly related to any other species of the genus. The form of the epiphallus and the bifurcated apex of the ventral ovipositor valves are unlike those of other species, although the clouded apical half of the hind wing is a character which recurs independently in several isolated montane species. It is likely, however, that *G. willemsei* has its origins in the *africanus-musicus* group which has radiated widely in Australasia, despite having evolved a number of unique features, not found in other members of the group.

MATERIAL EXAMINED

Holotype ♂, **New Guinea**: Irian Jaya, L. Habbema, 3250–3300 m, 3.viii.1938 (*Toxopeus*) (NHM, Maastricht).

Paratypes: **New Guinea:** 1 ♂, 1 ♀, L. Habbema, 3250–3300 m, 5.viii.1938 (*Toxopeus*) (NHM, Maastricht); 2 ♂, same data, 29.vii.1938 (NHM, Maastricht), 2 ♂, 1 ♀, same data, 4.viii.1938 (NHM, Maastricht); 1 ♂, same data (BMNH); 1 ♀, same data, 8.viii.1938 (BMNH); 1 ♀, same data, 12.viii.1938 (NHM, Maastricht); 1 ♀, same data, 7.viii.1938 (NHM, Maastricht); 1 ♀, same data, 13.viii.1938 (NHM, Maastricht); 1 ♀, L. Habbema, 3400 m, 24.viii.1938 (*Toxopeus*) (NHM, Maastricht); 1 ♂, 1 ♀, Letterbox Camp, 4 km E. of Wilhelmina Top, 3600 m, 7.ix.1938 (*Toxopeus*) (NHM, Maastricht); 1 ♂, same data (BMNH); 1 ♀, same data, 16.viii.1938 (NHM, Maastricht); 1 ♂, Oostzijde, Letterbox Camp, 4100 m, 28.ix.1938 (*Toxopeus*) (NHM, Maastricht).

DISTRIBUTION (Fig. 120, and Biogeography section, p. 317). Highlands of W. New Guinea.

DISCUSSION. This new species is named in honour of Dr Fer Willemse who kindly loaned the type-material.

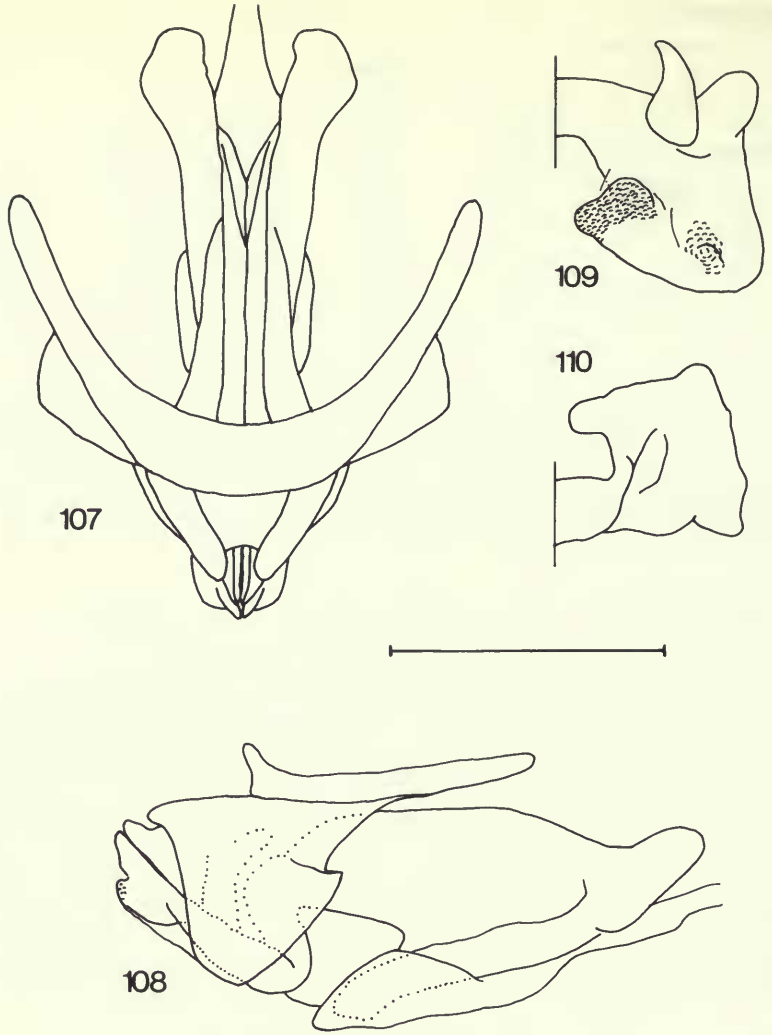
Gastrimargus sarasini (Saussure, 1884)

(Figs 107–110, 120, 152)

Oedaleus (*Gastrimargus*) *sarasini* Saussure, 1884: 1914. LECTOTYPE ♀, NEW CALEDONIA (NR, Stockholm), here designated [examined].
Gastrimargus sarasini (Saussure) Kirby, 1910: 228.
Gastrimargus sarasini (Saussure); Willemse, 1923: 102.

DIAGNOSIS. Fastigium of vertex concave, with triangular foveolae. Frons in profile straight, not convex. Pronotum with median carina arcuate, slightly inflated in prozona, sometimes narrowly intersected by posterior sulcus; hind margin sharply acutangular. Tegmen surpassing folded hind knees by one-quarter of hind femur length. Genitalia (Figs 107–110) with weakly protruding aedeagus.

Coloration dark brown with lighter markings. Pronotal ×-marking not usually visible, obscured by lighter colour on lateral margin of dorsum (Fig. 152). Tegmen blackish brown with 2 reduced pale cross-bands. Hind wing fascia (Fig. 152) complete; apical half of wing densely infumate in male, lighter in female; basal area of wing bright sulphur yellow. Hind femur externally mottled with indistinct banding; lower marginal area dark brown to black; internal medial area and ventral surface black. Hind tibia coral orange-red.



Figs 107–110 *Gastrimargus sarasini*, genitalia. 107, phallic complex, dorsal view; 108, same, lateral view; 109, epiphallus, right half, dorsal view; 110, same, posterior view.

MEASUREMENTS
Sample from New Caledonia.

	Males							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	28·31	3·90	5·74	21·41	15·11	3·42	4·42	3·68
Range	26·4–31·8	3·6–4·2	5·0–6·6	19·3–23·7	13·8–16·7	3·0–3·8	4·2–4·8	3·2–4·1
S.D.	1·327	0·149	0·385	1·935	0·665	0·183	0·143	0·180
n	29	30	30	29	30	30	30	29

MEASUREMENTS—(*cont.*)

	Females							
	Total length	Head width	Pronotum length	Tegmen length	Femur length	Femur depth	FL/FD	TL/PL
Mean	39·56	5·79	8·49	29·30	21·20	4·80	4·42	3·45
Range	37·1–43·7	5·4–6·2	7·5–9·8	26·4–32·6	19·9–23·1	4·3–5·1	4·0–4·7	3·1–3·7
S.D.	1·655	0·184	0·589	1·458	0·902	0·200	0·163	0·165
n	24	25	24	24	25	25	25	23

AFFINITIES. *G. sarasini* is presumably derived from the *africanus-musicus* stock which has produced a radiation of species in Asia and Australasia. The general dark coloration is a recurrent response to isolated montane or island habitats.

MATERIAL EXAMINED

Oedaleus (*Gastrimargus*) *sarasini* Saussure, lectotype ♀, **New Caledonia**: no locality (*Deyrolle*) (NR, Stockholm).

New Caledonia: 1 ♂, no locality (*Deyrolle*) (paralectotype of *G. sarasini*) (NR, Stockholm); 1 ♂, no data (paralectotype of *G. sarasini*) (MHN, Geneva); 1 ♀, Koinde (*Sarasin & Roux*) (MHN, Geneva); 1 ♀, no data (MHN, Geneva); 1 ♂, 1 ♀, Yahoué (MNHN, Paris); 4 ♂, 1 ♀, 1 nymph, no data (*Montague*); 1 ♂, 1 nymph, Canala, 1.vii.1914 (*Montague*); 1 ♀, Mt Canala, 11–15.vi.1914 (*Montague*); 9 ♂, 5 ♀, Mt Mou, 9–22.iii.1914 (*Montague*); 1 ♂, 4 ♀, Mt Mou, 12.iii.1914 (*Montague*); 1 ♂, Nouméa, v.1916 (*Cockerell*); 1 ♂, Nouméa, 20.i.1914 (*Montague*); 1 ♂, same data, 17.i.1914; 2 ♂, 1 nymph, Poya, near caves, xii.1965 (*Moore*) (ANIC, Canberra); 1 ♂, same data, i.1966 (ANIC, Canberra); 1 ♀, Moindou, 6–8.i.1966 (*Moore*) (ANIC, Canberra); 3 ♂, Hienghene, 0–50 m, i.1969 (*Krauss*) (BPBM, Honolulu); 1 ♂, Hienghene, 25.xi.1958 (*Joyce*) (BPBM, Honolulu); 2 ♂, Col des Roussettes, 350–450 m, 3.ii.1971 (*Krauss*) (BPBM, Honolulu); 1 ♂, Vallée d'Amoa, 7.ii.1963 (*Krauss*) (BPBM, Honolulu); 1 ♂, 1 ♀, La Crouen, 16.iii.1961 (*Sedlacek*) (BPBM, Honolulu); 1 ♂, same data, 12.iii.1961 (BPBM, Honolulu); 3 ♂, La Crouen, 150–250 m, ii.1973 (*Krauss*) (BPBM, Honolulu); 3 ♂, La Crouen, iii.1959 (*Krauss*) (BPBM, Honolulu); 2 ♂, 1 ♀, Col d'Amien, 750 m, 3.iii.1960 (*Gressitt*) (BPBM, Honolulu); 1 ♂, Nouméa, 26.viii.1940 (*F.X.W.*) (BPBM, Honolulu); 1 ♀, Nouméa, 27.ix.1940 (BPBM, Honolulu); 1 ♂, Noumea, i.1962 (*Krauss*) (BPBM, Honolulu); 1 ♂, Nouméa (BPBM, Honolulu); 1 ♀, La Foa, 17.iii.1961 (*Sadlacek*) (BPBM, Honolulu); 1 ♂, Sarramea, 12.iii.1963 (*Krauss*) (BPBM, Honolulu); 1 ♂, Bourail to Honailou, forest along road, iii.1959 (*Krauss*) (BPBM, Honolulu); 1 ♀, Plateau, 1.i.1963 (*Krauss*) (BPBM, Honolulu) 1 ♂, 3 ♀, Nepoui, viii.1940 (*F.X.W.*) (BPBM, Honolulu); 1 ♂, Mokone to Dothio, 150–500 m, 20,22.iii.1968 (*Gressitt*) (BPBM, Honolulu); 1 ♂, St Louis valley, 5.iv.1945 (*Milliron*) (BPBM, Honolulu); 3 ♂, 1 ♀, same data, 17.iii.1945 (BPBM, Honolulu); 1 ♀. Thi Forest, 29.x.–1.xi.1967 (*Sedlacek*) (BPBM, Honolulu); 1 ♂, same data, 100–300 m, 29.iii.1961 (*Sedlacek*) (BPBM, Honolulu); 2 ♂, same data, 28.iii.1961 (BPBM, Honolulu); 1 ♀, same data, 100–200 m, 9.iii.1961 (BPBM, Honolulu); 1 ♀, Mokone, 150 m, 20,22.iii.1968 (*Gressitt*) (BPBM, Honolulu); 1 ♂, Dothio, 7.i.1969 (*Krauss*) (BPBM, Honolulu); 1 ♂, Dogny Plateau, 9.iv.1973 (*Gressitt*) (BPBM, Honolulu); 1 ♂, Anse Vata, 21.iii.1961 (*Sedlacek*) (BPBM, Honolulu); 2 ♂, same data, 6.iii.1961 (BPBM, Honolulu); 1 ♀, Anse Vata, 27.x.1958 (*Joyce*) (BPBM, Honolulu); 3 ♂, same data, 23.x.1958 (BPBM, Honolulu).

DISTRIBUTION (Fig. 120, and Biogeography section, p. 319). New Caledonia.

DISCUSSION. The newly designated lectotype of *G. sarasini* was labelled as type by Saussure, but in his paper (1884: 114) he failed to designate a holotype from his syntype-series. Sjöstedt (1928: 33) refers to 'cotypes' in the NM, Vienna, and there is one male so labelled (not by Saussure) from Brunner's collection at Vienna, now deposited in the NR, Stockholm. All the original series in Vienna, Geneva, and Stockholm, should now be considered as paralectotypes.

Biogeography of *Gastrimargus*

The African fauna

Species of *Gastrimargus* exploit a wide range of climatic zones and vegetation types in Africa south of the Sahara. One area of species concentration is the temperate and subtropical montane grassland of south-eastern Africa where *G. wahlbergii* and *G. acutangulus acutangulus* are endemic (Fig. 111). Two other species, *G. crassicollis* and *G. drakensbergensis*, are also centred on this region (Fig. 112) but extend their ranges northwards into the Mopane woodland and westward along the south coast into the Cape macchia. The eastern plateau of southern Africa has provided a buffer zone for grassland species when lowland habitats have been wiped out by adverse climatic conditions. There is some evidence that similar grassland types have been more widespread in the past (Rattray, 1960). At the present day there are widely separated pockets of montane *Themeda*-dominated grassland on the Mozambique/Zimbabwe border and in Malawi between the large montane area of South Africa and the more dissected montane and semi-montane relicts of Kenya and Tanzania. The northern race of *G. acutangulus*, *G. a. flavipes* is associated with this type of vegetation in Kenya, and an intermediate form also occurs on the Nyika plateau of Malawi and Zambia (Fig. 111).

Another species, *G. verticalis*, shows a preference for savannah (Fig. 113). It is found in East Africa mainly east of the rift valley and crosses the *Brachystegia* belt by means of grassland 'stepping-stones' north of L. Malawi and on the Mozambique/Zimbabwe border. At times when the East African 'dry corridor' was open there would have been free interchange between the northern and southern savannahs (Winterbottom, 1967; Van Zinderen Bakker, 1976). The Kibariani mountains at Mpwapwa, Tanzania, are situated on the east side of a narrow tongue of savannah extending south-westwards into the woodland zone at the northern end of the 'dry

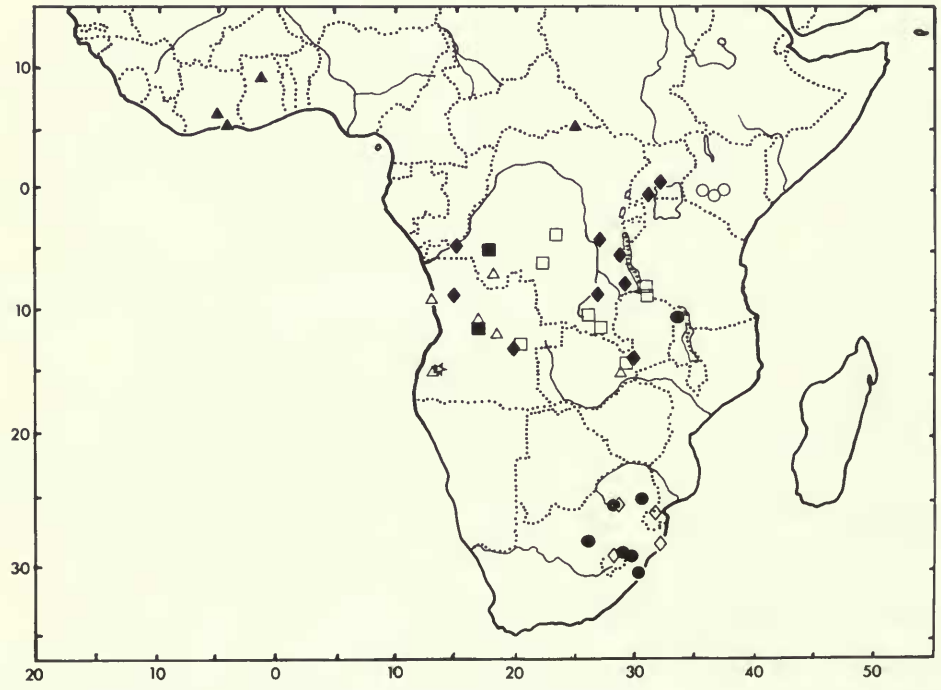


Fig. 111 Distribution of *Gastrimargus* species in Africa. Closed circles, *G. acutangulus acutangulus*; open circles, *G. a. flavipes*; star, *G. insolens*; open triangles, *G. angolensis*; closed triangles, *G. ochraceus*; open squares, *G. miombo*; closed squares, *G. obscurus*; open diamonds, *G. wahlbergii*; closed diamonds, *G. mirabilis*.

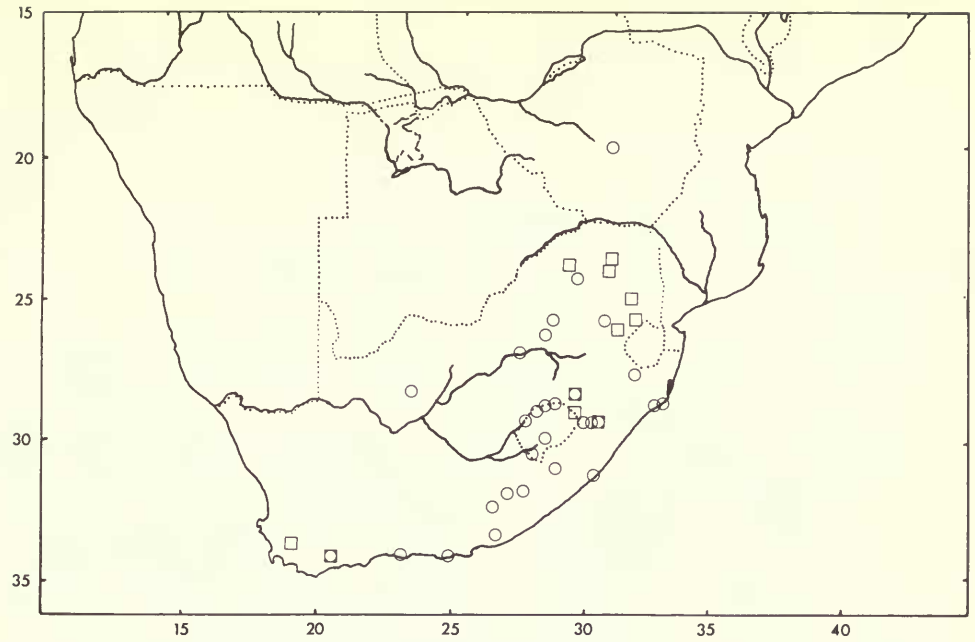


Fig. 112 Distribution of *Gastrimargus crassicollis* (circles) and *G. drakensbergensis* (squares) in southern Africa.

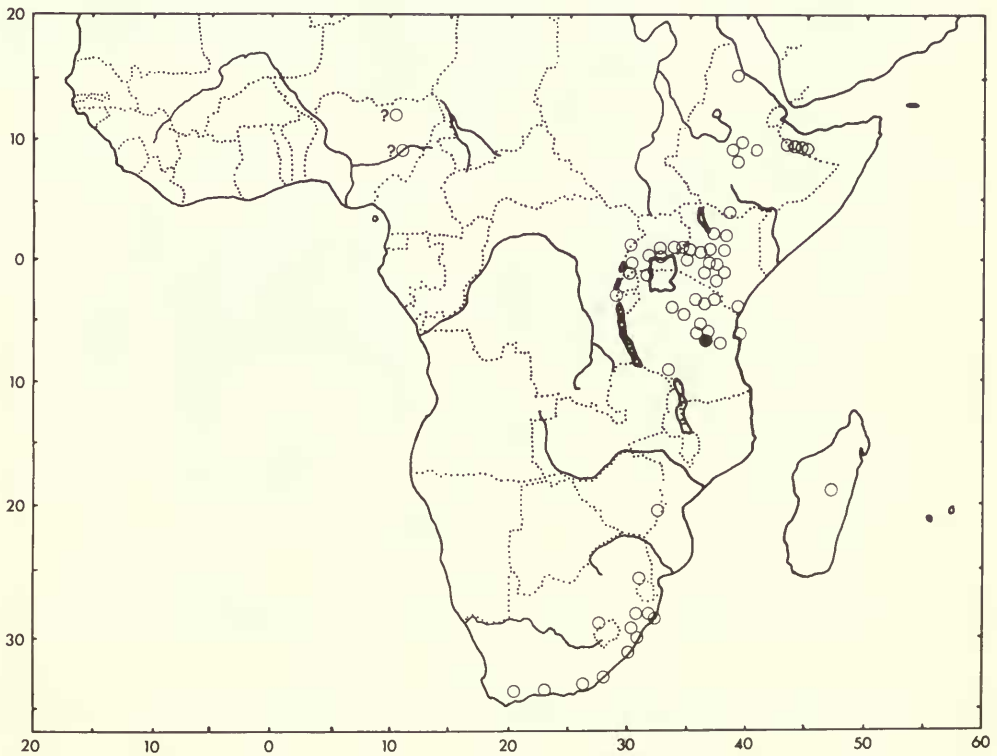


Fig. 113 Distribution of *Gastrimargus verticalis verticalis* (open circles) and *G. verticalis mpwapwae* (closed circles) in Africa.

corridor'. Except for the two relict patches of *G. verticalis* further south mentioned above, Mpwapwa is the furthest point in a south-westerly direction reached by the species in East Africa. It is therefore significant that a distinct race, *G. verticalis mpwapwae*, is found on these mountains. Greenway (1933) has given a brief description of their vegetation. The *Brachystegia* zone contains rare forest trees along stream margins, relicts from a past period of heavier rainfall. The summit carries a patch of evergreen forest (1830 m) which is encircled by *Protea-Dombeya* highland grassland, overlooked by Greenway. The highland grassland commences at 1650 m and is thought to have been derived from the forest, perhaps through the influence of fire (Burtt, 1942). Unfortunately the collector of the type-series of *G. v. mpwapwae*, Eric Burtt, did not specify the type of vegetation in which his specimens were found, but from the altitude (1800 m) it is probable that it was the *Protea* zone.

The vegetation of Mpwapwa has not apparently been compared in detail with that of the two isolated mountains less than 50 miles to the south and south-east (Gillman, 1949), but it is probable that there are considerable similarities. At times of recession of the *Brachystegia* the Kibariani mountains would have been surrounded not by the thin ring of woodland that exists today, but by savannah from which *G. verticalis* could have colonised directly. During times of expansion of the *Brachystegia*, the area would have been isolated, providing an opportunity for divergence and speciation among the endemic fauna. It is remarkable that nine species of Acridoidea are known only from Mpwapwa despite extensive collecting by E. Burtt and others all over Tanzania. The list includes one species each of Pneumoridae, Pamphagidae, Pyrgomorphidae and Lentulidae, and four Acrididae. A more intensive examination of the montane areas of Tanzania will no doubt reveal a more complex pattern of relict and endemic species since some at least of the Mpwapwa endemics must have had a wider distribution in the past.

At the northern extremity of the range of *G. verticalis* in Ethiopia there occur two species adapted to high montane habitats. The exact distribution of one of these, *G. hyla*, is unknown (see p. 268), but the other, *G. rothschildi* (Fig. 114), is found above the 2000 m contour. The range of this species has been discussed in detail on p. 270 in relation to geographical races. *G. rothschildi* and possibly *G. hyla* have been derived from *G. verticalis* in the relative isolation of the Abyssinian mountains, and the reduced wing length of the females in these species reflects their montane habitats.

G. determinatus vitripennis (Fig. 115) has a distribution in eastern and southern Africa sympatric with, but more extensive than that of *G. verticalis*. It is apparently unhindered by the *Brachystegia* zone and extends westwards to a line running north-east to south-west through Ethiopia, Uganda, and Angola, where another subspecies, *G. d. procerus* takes over, occurring on both the northern and southern fringes of the rain forest, and extending westwards to Senegal. This type of distribution is interesting and can be accounted for by reference to past climatic changes in the area. During glacial periods (Van Zinderen Bakker, 1976) the northward movement of the cold Benguela current and the associated decline in precipitation and increase in wind desiccation were responsible for the redistribution of Kalahari sand as far as the Zaire river. The miombo woodland was pushed northwards and the western Congo basin forest may have been breached.The present-day intrusion of tall grass savannah/forest mosaic into the forest in the Congo Republic (Keay, 1959) is largely rooted in Kalahari sand with grass associations dominated by *Loudetia* spp. (Rattray, 1960). From this it may be inferred that a north to south savannah/woodland corridor was created which facilitated the interchange of species between western and southern Africa across the Congo forest. This corridor was not as well-defined or as arid as that in east Africa but would have permitted species like *G. determinatus* with a wide tolerance of vegetation and climate to cross. It is not clear in which direction the movement took place. The nominate subspecies, *G. d. determinatus*, occurs in Cape Province, though precise localities are unknown, and it has a fully banded hind wing (Figs 139, 140), probably the 'primitive' condition for the species. *G. d. procerus* has a partial band (Fig. 137) which is generally most developed in males from the Congo region ('*G. silvicola*' Sjöstedt) and *G. d. vitripennis* (Fig. 138) has no band on the hind wing. The most reasonable model for the development of the three subspecies is that *procerus* arose from *determinatus*, and *vitripennis* from *procerus*, with the progressive loss of the hind wing fascia in the process. In Arabia a fourth subspecies, *G. d.*

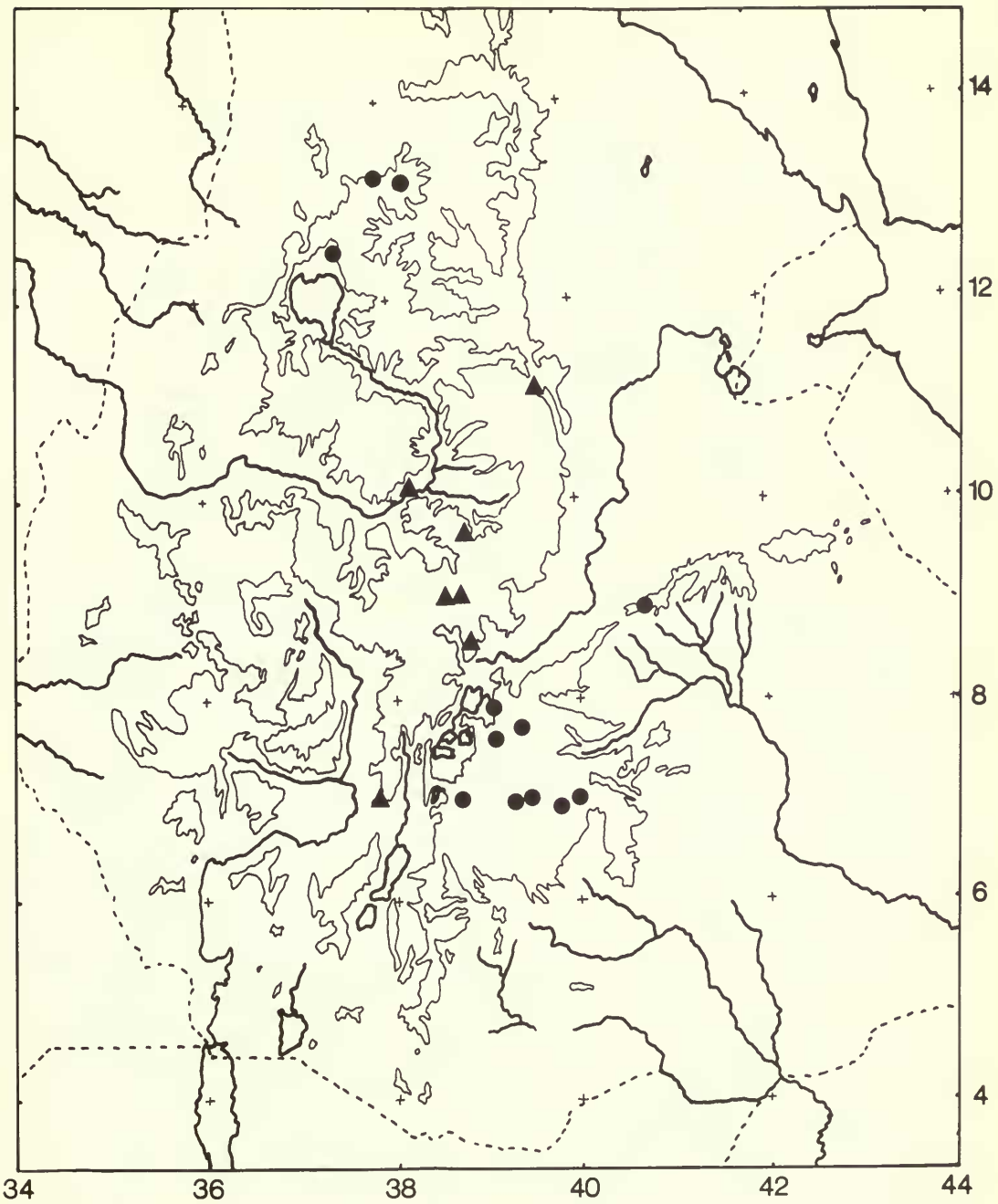


Fig. 114 Distribution of subspecies of *Gastrimargus rothschildi* in Ethiopia. *G. r. rothschildi*, circles; *G. r. luteifemur*, triangles. The 2000 m contour is represented by a thin continuous line.

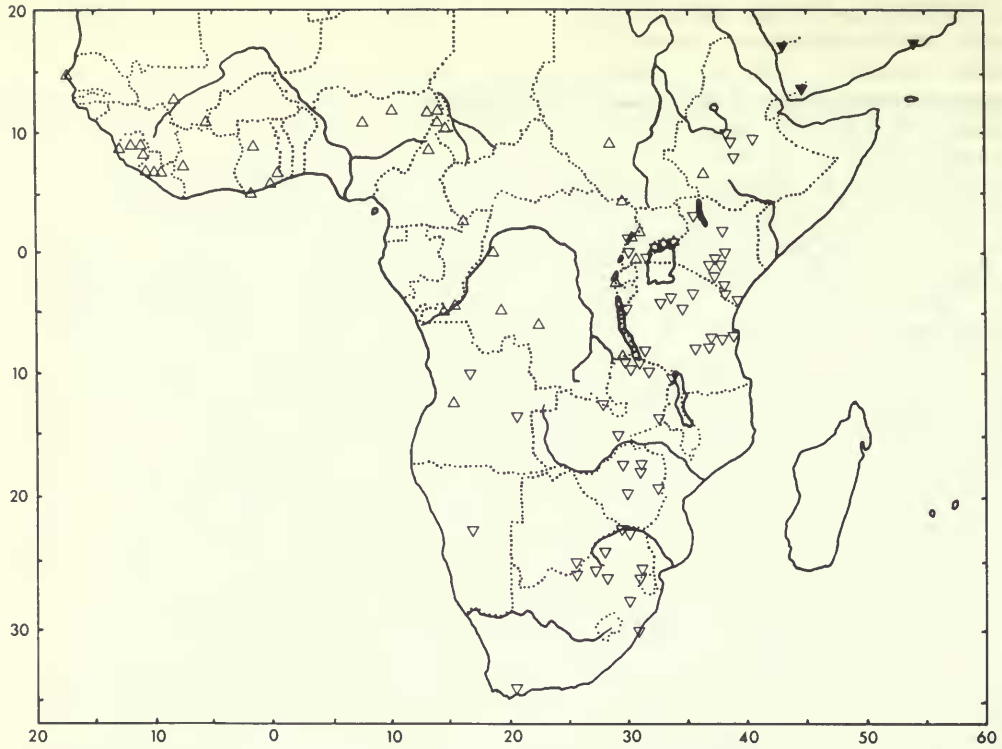


Fig. 115 Distribution of subspecies of *Gastrimargus determinatus* in Africa and Arabia. *G. d. procerus* (upright open triangles), *G. d. vitripennis* (reversed open triangles), and *G. d. arabicus* (reversed closed triangles).

arabicus, which also lacks the hind wing band, has been derived from the north-east fringe of the distribution of *G. d. vitripennis* across the Red Sea in Ethiopia.

The largest concentration of *Gastrimargus* species occurs in central Africa south of the equator, in and around the *Brachystegia* woodland and the moist woodland and forest/savannah mosaic zones (Keay, 1959) (Fig. 111). The members of this geographical assemblage are morphologically diverse. The most extensive range is that of *G. mirabilis*, the only member of the group to cross the rift valley, penetrating as far east as SW. Uganda. *G. angolensis*, *G. miombo*, and *G. obscurus* are more restricted in range, but their relative rarity precludes any meaningful discussion of their precise distribution. The unique locality of *G. insolens*, Sá da Bandeira, is situated on an isolated massif at the south-western extremity of the Angolan plateau. The mountain is capped with forest but otherwise the vegetation is *Brachystegia* woodland with a *Hyparrhenia* grass association different from that of the lower altitude, lower rainfall areas around. At present it is not certain that this species is absent from similar vegetation in the montane area further north, west of Nova Lisboa. However, the isolated location of Sá da Bandeira at the tip of a peninsula of miombo projecting into the hotter, drier 'mopane' belt suggests that the species may be a relict from one of the periods of Kalahari expansion mentioned above. During such a period the miombo woodland would have receded further north except for an isolated patch on this mountain acting as a refuge for species of more humid habitats. None of the *Gastrimargus* species endemic to the *Brachystegia* zone have been recorded east of a line from the east end of L. Rukwa south along the Luangwa valley to the Zambezi. This line follows the course of the 'arid corridor' which divided the woodland during glacial periods. The absence of these species in similar vegetation to the east of the corridor suggests either that they evolved in the west during a period when the woodland was divided and have failed to expand their ranges since, or that they have been wiped out east of the corridor by even more severe conditions at glacial maxima.

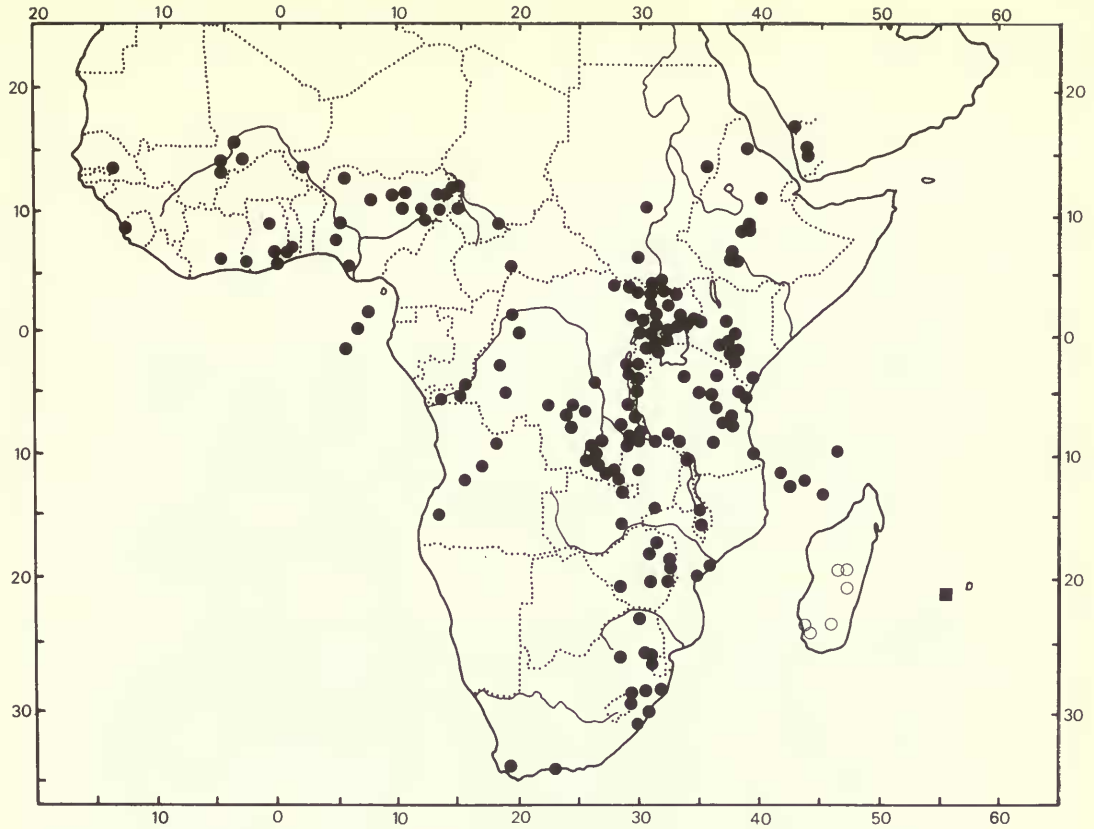


Fig. 116 Distribution of *Gastrimargus* species in Africa, Arabia and neighbouring islands. *G. africanus africanus* (closed circles), *G. africanus madagascariensis* (open circles); *G. immaculatus* (square).

West Africa is relatively poor in endemic non-forest species of Acrididae, presumably as a result of the climatic instability of the area during the Pleistocene (Moreau, 1966; Ritchie, 1981). *G. ochraceus*, the only species of the genus endemic to this region, was known until recently only from Ghana and Ivory Coast where it extends from the *Isoberlinia* woodland (northern Guinea savannah) to the forest/savannah mosaic. It is now reported from similar country on the northern border of Zaire in the centre of the continent. This species and many other non-arid faunal elements occurring in West Africa today have probably moved westwards from central Africa where there have been suitable refuges on the northern fringe of the Congo forest when similar habitats in West Africa were reduced or destroyed by desert encroachment.

Gastrimargus africanus, the most ecologically tolerant species in the genus, is found very widely in Africa (Fig. 116), even occurring, presumably in clearings, deep in the Congo forest. However, it avoids dry savannah and semi-desert, as for example in Namibia, Botswana, and Somalia. The wide tolerance and high vagility of the species have uniquely equipped it for expansion not only within Africa but across Asia as well. Around the continental margin of Africa *G. africanus* extends, apparently unaltered, into the Comoro Is., Aldabra and the SW. corner of Arabia, but in Madagascar it has given rise to a separate subspecies *G. a. madagascariensis.*

The Asian fauna

G. africanus reappears in western India (Fig. 117), the nominate sub-species being replaced by *G. a. sulphureus* in Pakistan, Kashmir and Nepal, and NE. India above 2000 m. In east Asia there is a gradual replacement of the nominate subspecies by *G. a. parvulus* which tends to lose the bright yellow wing colour and the blue underside of the hind femur. The distribution of this subspecies is

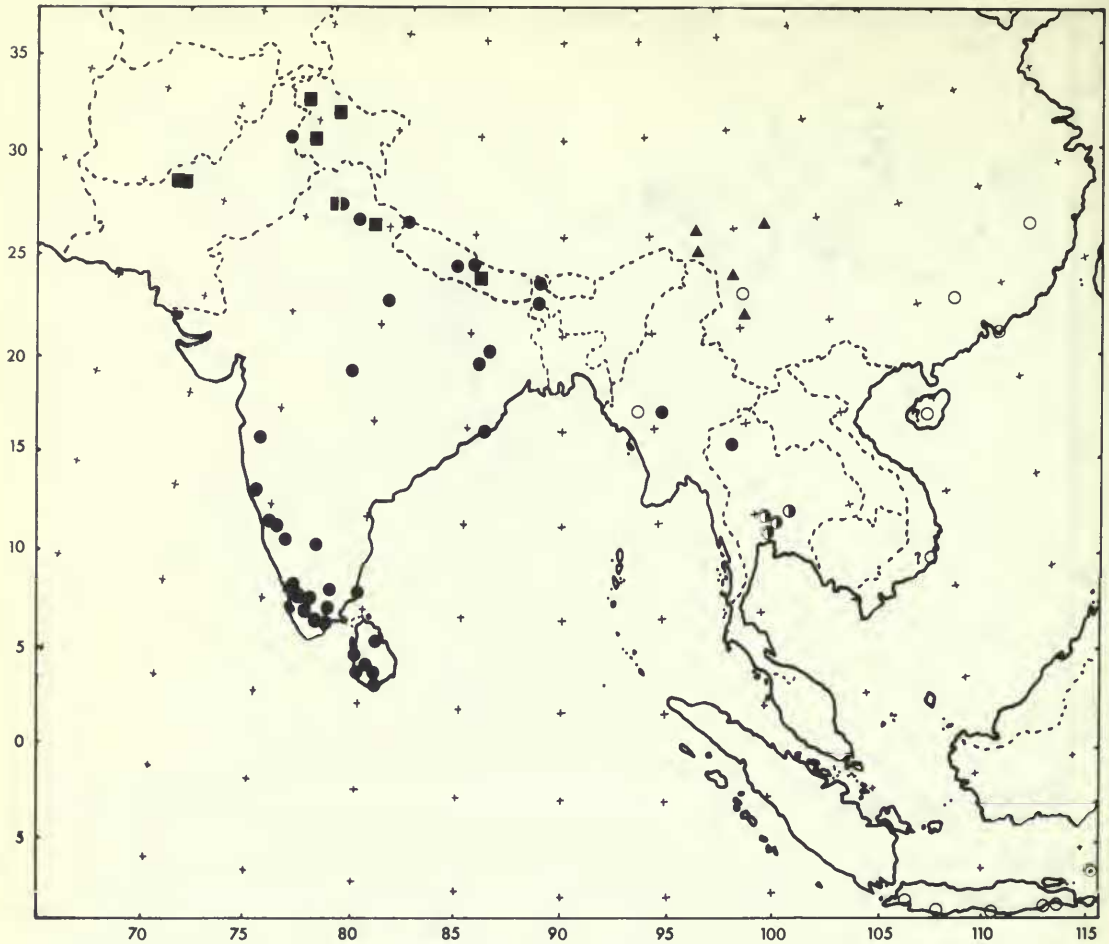


Fig. 117 Distribution of *Gastrimargus* species and subspecies in Asia. *G. a. africanus* (closed circles), *G. a. parvulus* (open circles), intermediates (half-closed circles), *G. a. sulphureus* (squares), and *G. nubilus* (triangles).

disjunct between Indo-China and the south coast of Java, avoiding the intervening rain forest areas of Malaya and Sumatra. The remaining species endemic to mainland Asia, *G. nubilus*, is closely allied to *G. africanus* and is adapted to the mountains of southern China north of the Burma border on the NE. edge of the range of that species (Fig. 117). As stated on p. 253, *G. nubilus* has probably been derived from *G. africanus* under the influence of montane conditions. *G. immaculatus*, an island endemic species from Réunion in the Indian Ocean (Fig. 117), is presumably also related to *G. africanus*, but the relationship is not very close (see p. 267). The subspeciation of *G. africanus* in Asia and the existence of a closely related species there, as against the absence of any distinct subspeciation in Africa, suggests that the species may have originated in Asia and moved into Africa rather than the reverse. The question remains open.

The Malesian fauna

The name Malesia has been coined to describe the area between the mainland of Asia, bounded by the Kra isthmus of the Malay peninsula and the Bashi channel north of the Philippines, and Australia, bounded by the Torres strait (Whitmore, 1975). The islands of Malesia have been the setting for a radiation of *Gastrimargus* species best understood against the background of the

physical characteristics and vegetation of the region, both past and present. The flora of Malesia is highly distinct, with more than 40 per cent of the species endemic, and with a total of more than 2000 genera retained or excluded by the barriers described above (Whitmore, 1975).

Within Malesia, the 200 m submarine contour defining the Sunda shelf, the Asian continental shelf, includes the islands of Sumatra, Java, and Borneo. Sumatra and Borneo carry a floristically similar type of rain forest, but Java with its seasonally dry climate has a more open monsoon forest. At certain times during the Pleistocene the sea level in this area has dropped about 100 m, uniting these islands (Haile, 1971) and presumably producing drier conditions in Malesia. Botanical evidence for the past extension of seasonally dry habitats is provided by drought-loving species of Papilionaceae which are now not found anywhere between monsoon Asia and Java, but which must have had continuous distributions in the past. They probably crossed the intervening space via the Philippines, the Celebes, and the Moluccas, which even today form a north to south sequence of seasonally drier climates between the ever wet Sunda and Sahul shelves (Whitmore, 1975). However, the fact that *G. africanus* has only become established in Java and not in any of the northern islands suggests that it reached there via the Malay peninsula from the mainland when seasonally drier climates were more widespread. Specimens from Java closely resemble those from the mainland, possibly indicating that the species has become established fairly recently, perhaps during the last glaciation when rain forest in N. Queensland is known to have been temporarily replaced by sclerophyll forest, evidence of drier conditions in the region at that time (Walker, 1970).

Java and Bali mark the eastern boundary of the Sunda shelf and the area which was part of continental Asia during glacial maxima. Further east the islands of Lombok, Sumbawa, and Flores were separate from Bali though joined to each other. This separation is largely responsible for the striking impoverishment of the fauna to the east of the dividing line known as Wallace's line. For example, 68 species of birds found on Bali are absent from Lombok (Mayr, 1944). In addition to permanent separation from the continental shelf, the volcanic nature of the islands must have hindered the dispersal of animal species along the chain of islands. Flores and the eastern islands emerged during the late Miocene after Lombok and Sumbawa and many of the volcanoes of eastern Flores and the smaller islands between Flores and Alor are still active today (Norvick, 1979).

Wallace's line is not a distinct limit for plants, as shown above, nor for insects at genus level (Gressitt, 1961). However, at species level and below there are interesting changes. *G. africanus* does not reach Lombok and has not yet been recorded from Bali. It does, however, occur on Kangean, the largest and most westerly island of the Kangean archipelago, on the edge of the continental shelf. *G. lombokensis*, a species closely related to *G. africanus* and to the Australian species, *G. musicus*, occurs on Lombok, Flores, Sumba and Sumbawa (Fig. 118). It is now also

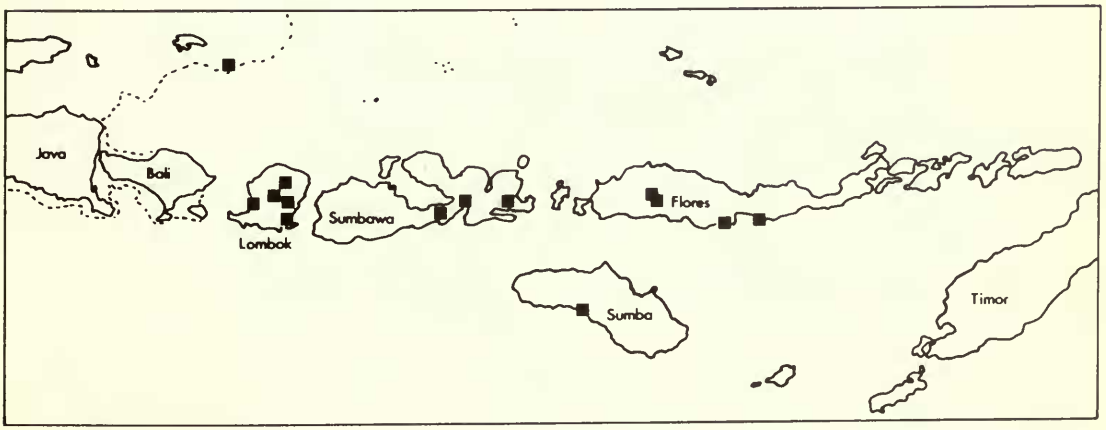


Fig. 118 Distribution of *Gastrimargus lombokensis* in the Lesser Sunda Is. The 200 m marine contour delimiting the Sunda shelf is shown as a broken line.

known from Sepandjang, the most easterly of the Kangean Is., demonstrating the ability to cross 130 km of open water, probably blown by the southern monsoon. The prevailing monsoon winds blowing from Australia are responsible for the relatively dry conditions in all the Lesser Sunda Is. including Timor.

In contrast to the inner arc of islands from Lombok to Alor, the outer arc, including Timor and Roti, is now thought to have been part of the Australian continental margin since the Palaeozoic era (Audley-Charles *et al.*, 1972), originally separated from the islands to the north by more than 1000 km. After starting to move northwards at the end of the Mesozoic on the leading edge of the Australian plate, Timor arrived at its present position in the middle Pliocene, emerging above water in the late Pliocene and continuing to rise until the present (Norvick, 1979). Despite being part of the Australian continental plate, Timor is not part of the Sahul shelf defined by the 2000 m submarine contour surrounding Australia and New Guinea, and is separated from Australia by a deep trench. It has therefore never formed part of the continental land mass during periods of Pleistocene sea level depression. This isolated island has its own distinctive species of *Gastrimargus*, *G. subfasciatus* (Fig. 120), which has, however, strong links with *G. lombokensis*. The unusual blue pigmentation of the hind wing of *G. subfasciatus* replaces the pale yellow wing of *G. lombokensis* but this is probably a simple development in evolutionary terms. Both *G. marmoratus* and *G. wahlbergii* possess a very faint blue tint at the wing base on an otherwise pale yellow or greenish yellow wing. *Oedaleus decorus* bears similar coloration although its near relative *O. senegalensis* has no trace of blue pigment.

O'Toole (1975), discussing the dispersal of the velvet ant *Timulla oculata* (F.) to the east of Wallace's Line, noted that the most distinctive subspecies were found on Timor and Tanimber Larat which are furthest away from the putative source area. He concluded that the populations on these islands must have undergone the most rapid evolution. Their distant origin and the consequent exotic fauna carried by these islands prior to their arrival in proximity to the islands of the inner Banda arc have no doubt strongly influenced the adaptive modification of later colonising species.

In contrast to the pattern of insular speciation in Malesia discussed above, the distribution of *G. marmoratus* (Fig. 119) is geographically and ecologically wide. The species is able to tolerate both the everwet climates of Borneo and Malaya and the seasonally dry regime of Sumbawa and Flores. This is a large, long-winged species of high vagility, attested by its presence in areas as remote from each other as the Vogelkop peninsula of New Guinea and Hokkaido island, Japan. In mainland Asia the distribution map suggests a preference for coastal areas, but the known range, especially in China, is probably very incomplete.

The Australasian fauna

The only *Gastrimargus* species endemic to Australia, *G. musicus* (Fig. 120), is widespread and common in areas with 500–1500 mm of annual rainfall, and also occurs less commonly in drier areas. To some extent the collecting localities reflect the distribution of roads and population rather than of the insects themselves, as for example the line of records across the southern end of the Cape York peninsula, following the road from Normanton to Clarke River. In New Guinea the species is only found in the drier areas of the southern coast opposite Cape York and along the eastern peninsula. Specimens from eastern New Guinea and the Solomon Is. differ in colour from the main population (see p. 262), indicating that separation by rain forest and by a wide tract of open sea respectively have initiated the process of subspeciation. At present *G. musicus* is only known from Guadalcanal in the Solomons group but it may also occur on neighbouring islands.

G. musicus bears a strong resemblance to *G. africanus* to the extent that some specimens of the two species from the Solomon Is. and Java respectively may be almost indistinguishable (see p. 243). It is likely that *G. musicus*, *G. lombokensis* and *G. subfasciatus* all evolved from a common ancestor which had the red undersides to the hind femora which these species all share. How this ancestor was related to *G. africanus* is not clear. It is less likely that *G. musicus* is derived from *G. lombokensis* which must also have evolved from an ancestor close to *G. africanus* by a process which has included the loss of the bright yellow basal area of the hind wing and the modification

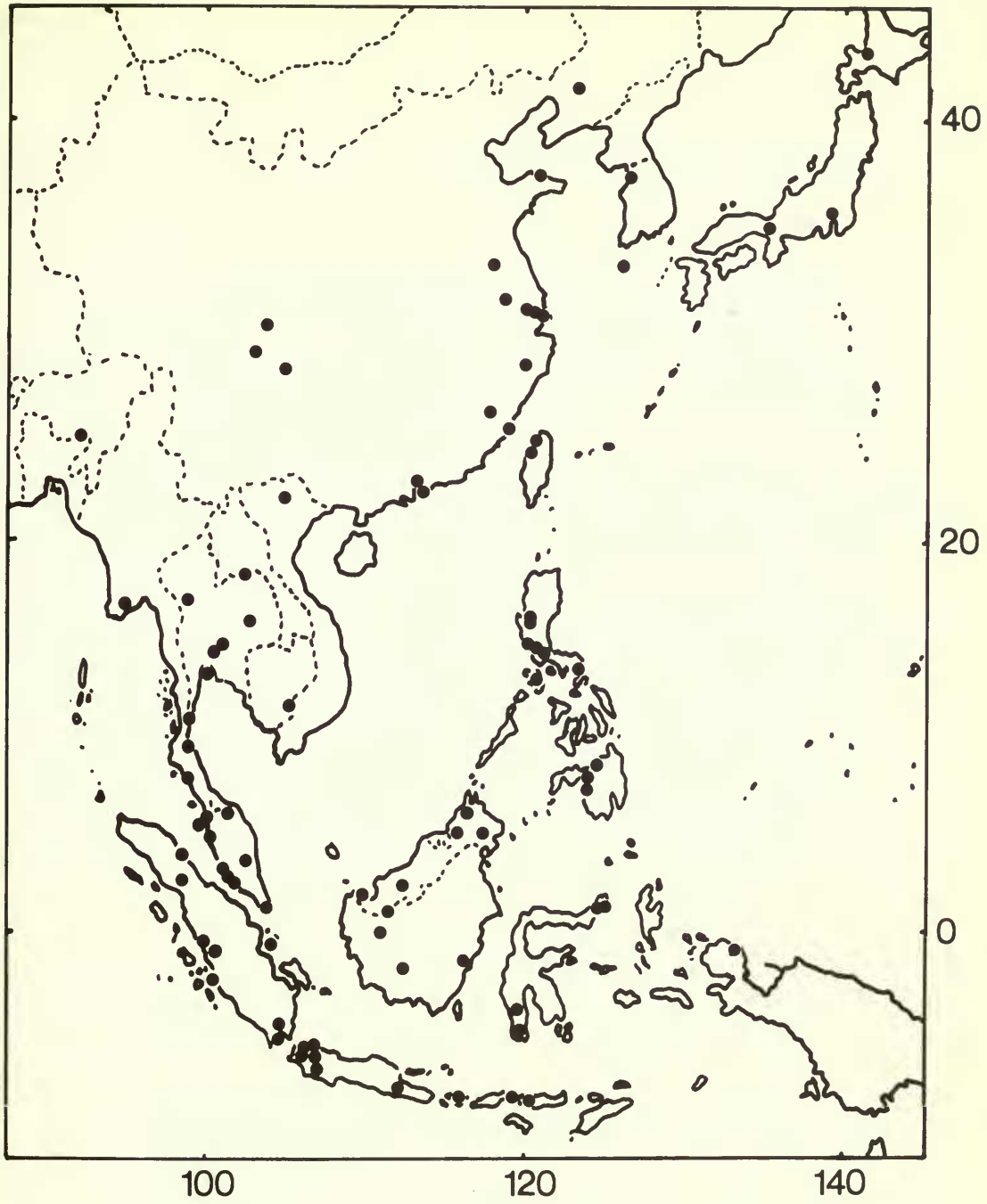


Fig. 119 Distribution of *Gastrimargus marmoratus* in South East Asia.

of the wing band. It is unlikely that *G. musicus* could have regained these features just as they are found in *G. africanus* when once they had been lost.

The remaining species known from New Guinea, *G. willemsei* (Fig. 120), is apparently restricted to the central mountains of Irian Jaya between 3250 and 4100 m. It appears to be only distantly allied to the other South East Asian species, and exhibits the familiar wing reduction and dark

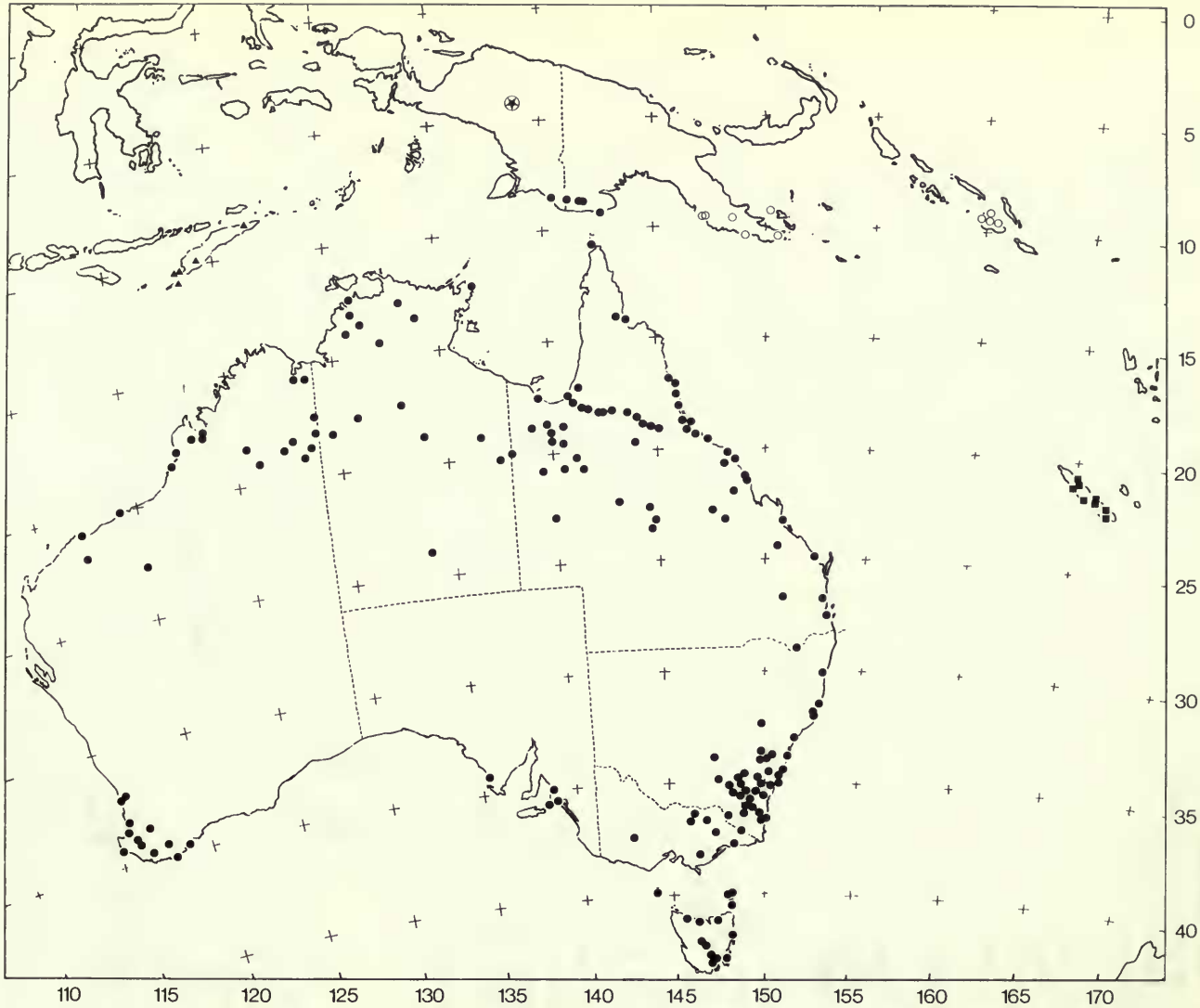


Fig. 120 Distribution of *Gastrimargus* species in Australasia. *G. musicus* (closed circles), pale-winged race (open circles); *G. sarasini* (squares); *G. subfasciatus* (triangles); *G. willemsei* (circled star).

pigmentation associated with a montane existence. New Caledonia is the furthest point reached by *Gastrimargus* in its eastward radiation from its putative source areas in Africa and Asia. Here, 1200 km east of the coast of Australia, there is one species, *G. sarasini* (Fig. 120). This species also is not closely allied morphologically to its neighbours but presumably represents an early offshoot from the *africanus-musicus* stock. It is not at present certain that this or some other species does not occur on the islands of the New Hebrides to the north east of New Caledonia, since collections from this part of the world tend to be aggregated around the more populous administrative centres.

General discussion

The distribution of the genus *Gastrimargus* offers some interesting points of comparison with that of *Oedaleus* (Ritchie, 1981). In both genera there are several species centred on the high grasslands of eastern South Africa, Lesotho and Swaziland. However, in *Oedaleus* the most intense speciation has occurred in the East African savannah and semi-desert, whereas *Gastrimargus* in Africa is centred on the *Brachystegia* woodland south of the Congo forest, a habitat which supports only one species of *Oedaleus*, *O. nigeriensis*. This area has been little studied by acridologists and may be expected to yield further new species of grasshoppers.

Outside Africa the contrast between the two genera is even more marked. In *Oedaleus* there is a clear discontinuity between the eastern seaboard of Indo-China and the south-east coast of New Guinea where the unique Australasian endemic, *O. australis*, is first encountered. For *Gastrimargus* with its greater tolerance of humid habitats, the intervening islands of Malesia have been the setting for a secondary radiation of species.

Overall there is a clear tendency for *Gastrimargus* to occupy more humid habitats than those favoured by *Oedaleus*. This is strikingly illustrated by a comparison of the number of montane species with restricted ranges in the two genera, excluding the species of the high veldt of eastern Africa. In *Oedaleus* there is only one species, *O. formosanus*, in this category, whereas there are five species and one subspecies of *Gastrimargus*. This figure reflects the effect of past periods of low rainfall when montane refuges have trapped populations of non-savannah species. *Oedaleus*, with its more xerophilous habitat preferences, is not susceptible to this effect since dry glacial periods would have increased its range rather than the reverse. In both genera adaptation to montane conditions is associated with shortening of the tegmina and wings and darkening of the body coloration, notably the hind wings. This latter effect is independent of the morphometric changes and only occurs in some cases. It may also be observed in long winged populations on islands, as for example in *G. sarasini* on New Caledonia.

Acknowledgements

This revision forms part of a thesis approved by the University of London for the award of the degree of Doctor of Philosophy. I am most grateful to my Supervisor, Dr N. D. Jago, and to my Director of Studies, Dr N. Waloff, for their advice and encouragement throughout the course of this study.

I am indebted to the Trustees of the British Museum (Natural History) and to the Keeper of Entomology for access to the collections which form the basis of this work, and to the following individuals for the loan of specimens and other assistance: Dr P. Basilewsky (Tervuren), Dr H. D. Brown (Pretoria), Dr F. Capra (Genoa), Dr G. Demoulin (Brussels), Dr F. N. Dingemans-Bakels (Maastricht), Dr P. H. van Doesburg (Leiden), Dr M. Donskoff (Paris), Dr D. Duviard (Abidjan), Dr K. K. Günther (Berlin), Dr A. Gurney (Washington), Dr B. Hauser (Geneva), Dr L. Hedström (Uppsala), Mr J. Houston (Church Stretton), Dr P. Johnsen (Aarhus), Dr K. H. L. Key (Canberra), Dr T. Kronestedt (Stockholm), Mrs B. Laosinchai (Bangkok), Dr G. Messana & Ms S. Mascherini (Florence), Dr L. L. Mishchenko (Leningrad), Dr G. M. Nishida (Honolulu), Dr D. Otte & Dr H. R. Roberts (Philadelphia), Dr G. Petersen (Eberswalde), Dr D. R. Ragge (London), Dr D. Rentz (San Francisco), Prof. H. Strümpel (Hamburg), Mr E. Taylor (Oxford), Dr F. Willemse (Eygelshoven). Thanks are also due to Mrs G. Colquhoun and Mr P. Turner for photography.

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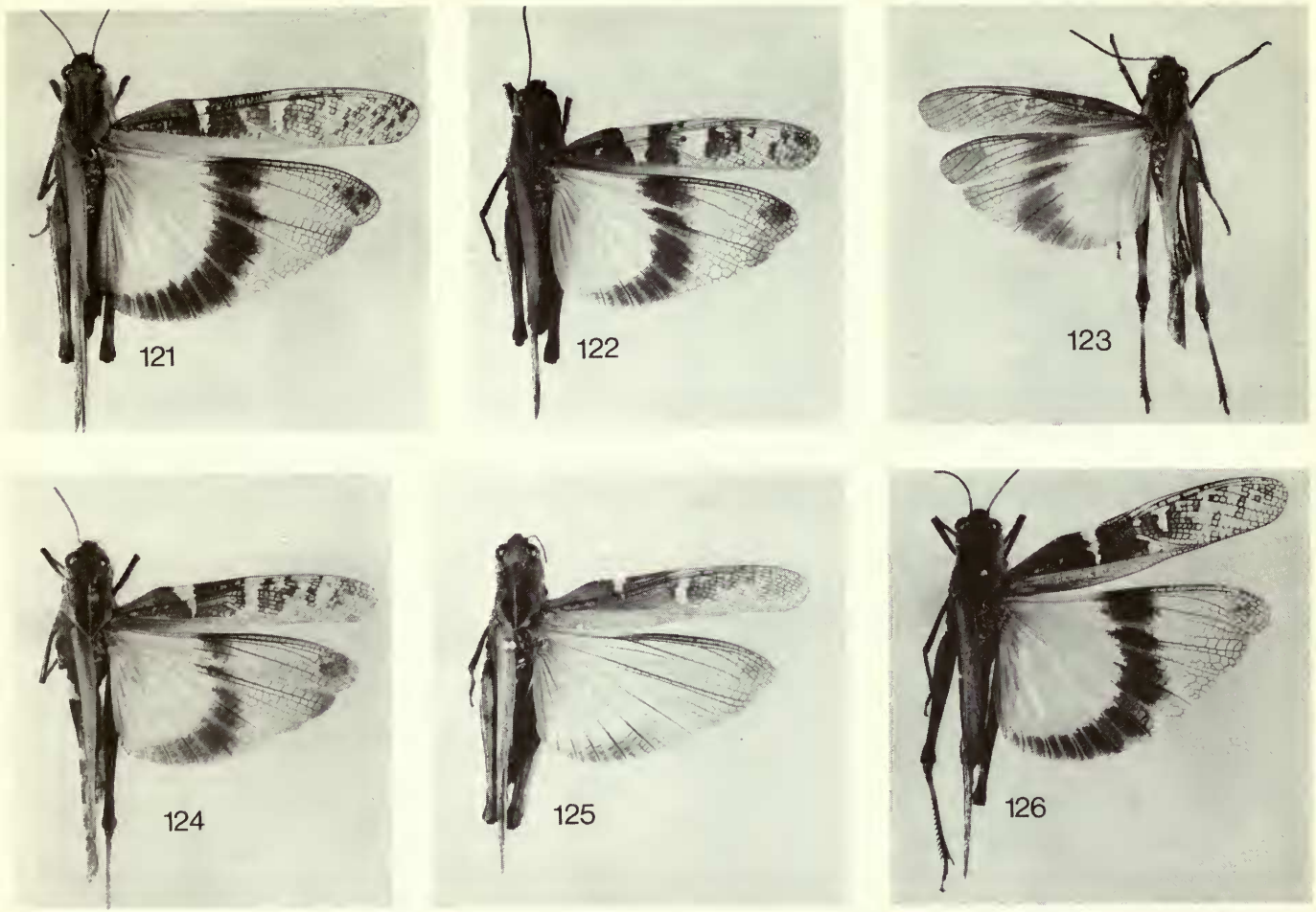

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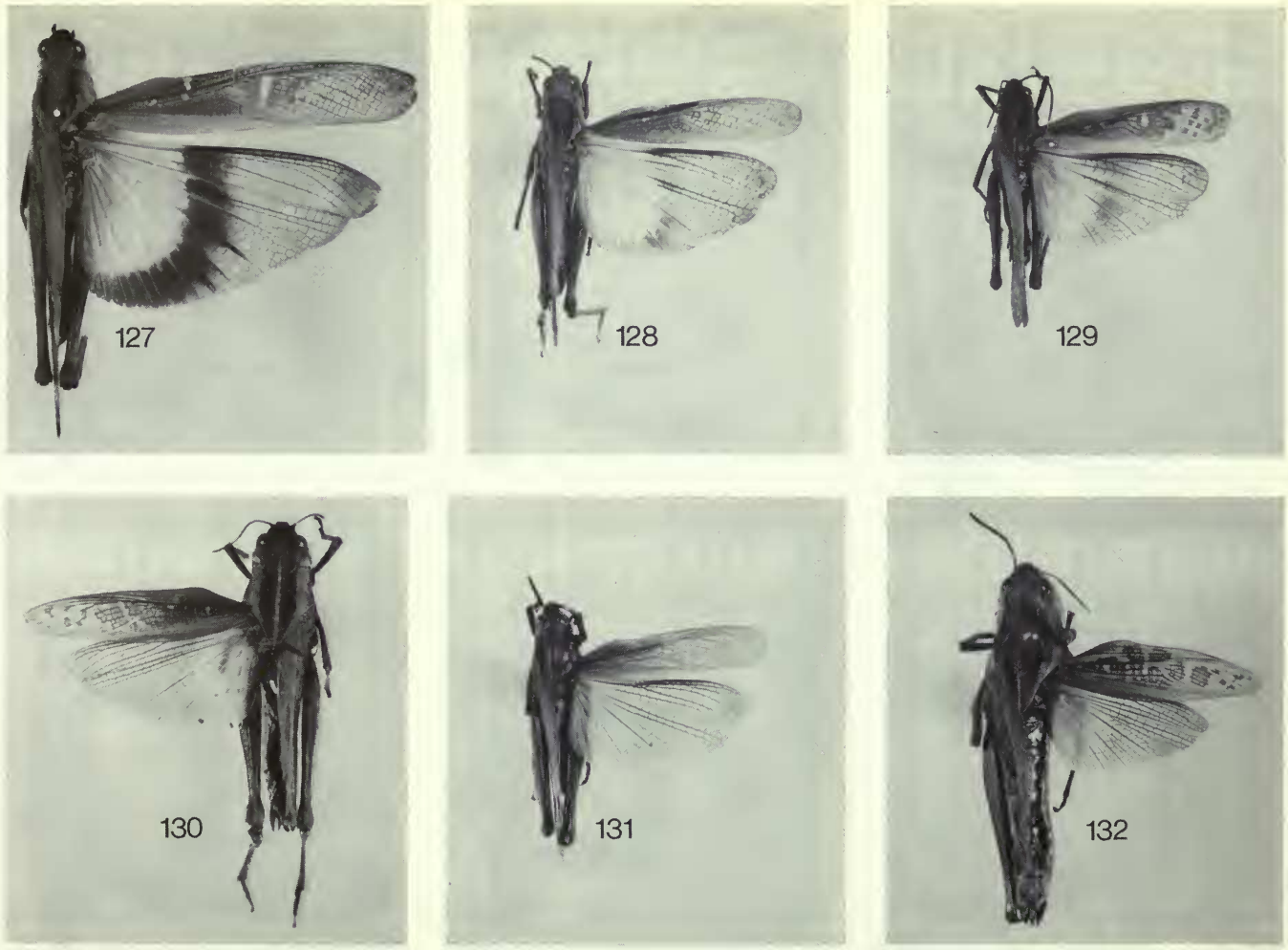

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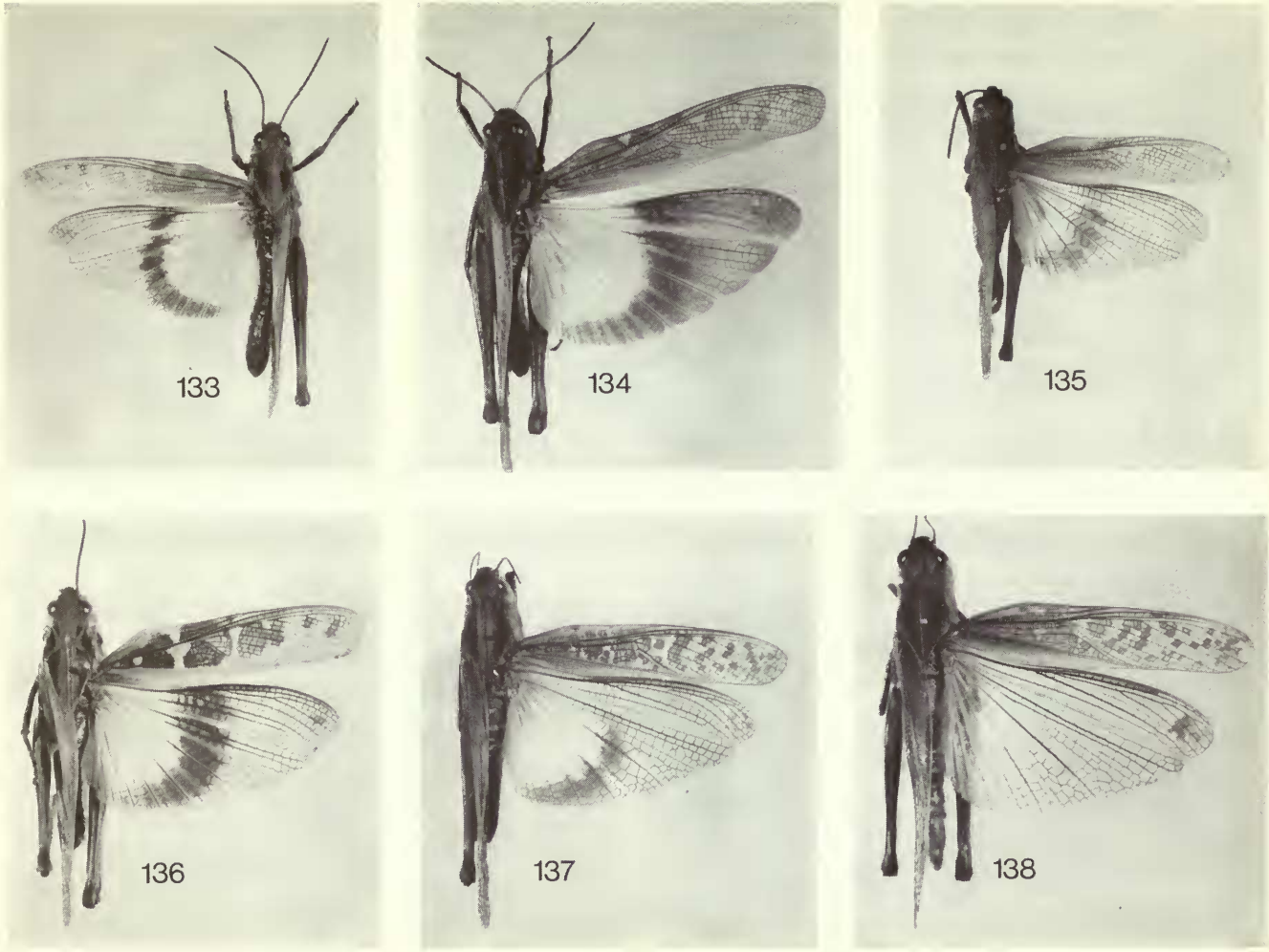

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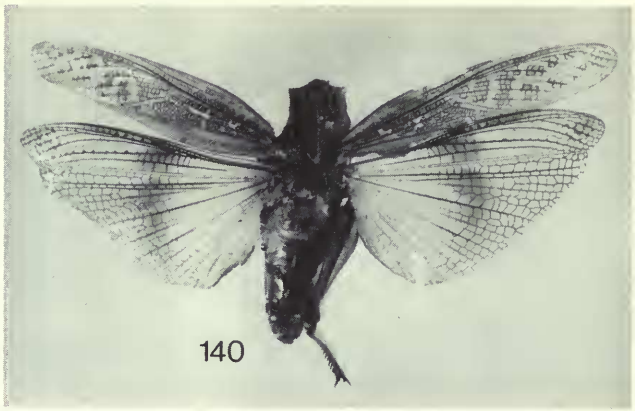

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